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A SYSTEM

OF

PRACTICAL THERAPEUTICS.

EDITED BY

HOBART AMORY HARE, M.D.,

PROFESSOR OF THERAPEUTICS AND MATERIA MEDICA IN THE JEFFERSON MEDICAL COLLEGE OF PHILADELPHIA.

ASSISTED BY

WALTER CHRYSTIE, M.D.,

LATE PHYSICIAN TO ST. CLEMENT'S HOSPITAL, AND INSTRUCTOR IN PHYSICAL DIAGNOSIS IN THE UNIVERSITY OF PENNSYLVANIA.

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CROUPOUS AND CATARRHAL PNEUMONIA.

By EDWIN E. GRAHAM, M. D.

CROUPOUS PNEUMONIA.

General Considerations.

The treatment of croupous pneumonia must necessarily be influenced by our opinion of its causation and pathology. Exposure to cold, the excessive use of alcohol, improper nourishment, bad hygienic surroundings, nervous shock, severe injuries, or any cause that depresses the vital forces, predisposes the individual to pneumonia. Certainly, unless we accept this explanation of its origin, the exciting cause of many cases of pneumonia must remain in doubt.

On the other hand, from the studies of bacteriologists it would appear that croupous pneumonia is not invariably due to a single cause, and that cases differing neither in symptoms, physical signs, nor post-mortem lesions may originate under quite different conditions. Nevertheless, after carefully considering all the circumstances, the weight of evidence clearly tends to the belief that the lung inflammation probably depends on an antecedent change about which, histologically, we as yet know nothing. Thus pneumonia—or rather the processes in the lung which have previously been so called—occupy but a subordinate place in a series of phenomena of which the lung-changes are only a part. It does not, however, come within the scope of this paper to discuss this aspect of the subject. All must admit, however, that as regards the bacteriology of pneumonia there is as yet scarcely sufficient evidence to establish the dependence of the disease upon one specific germ.

Whatever opinion we may hold as to the causation, it must be admitted that in the typical form of the disease manifestations of inflammation in the pulmonary structure are uniformly present. Pneumonia, unlike other inflammations, is seldom produced by artificial means, nor have we, as is usual with inflammations in other organs, a definite line of symptoms following, *pari passu,* the progress of the inflammation in its full extent and severity. The physical signs of consolidation may not develop until several days after the appearance of the pyrexia, and the ratio of fever and area of lung involved is often far from constant. Considerations such as these, together with the knowledge that inoculation has been successful in

exciting the disease in animals, such as mice, guinea-pigs, and rabbits, and that no affection due to a local cause produces symptoms so definite in point of time as croupous pneumonia, are opposed to the view that pneumonia is nothing more than a local inflammation.

Realizing, then, that we do not have to contend with an inflammation, but rather with a constitutional disease, and one, moreover, of comparatively short duration, we readily adopt an expectant treatment, ever alert, interfering only when necessary, and not seeing in the mere name of the disease any special indications for treatment. The tendency in all acute infectious diseases is toward cure, and the physician's duty is clearly to sustain life until recovery takes place. Each case must be treated by itself, the prognosis in any given case often largely depending upon the skill the physician employs in combating each indication as it arises. One point, however, must always be remembered—namely, that all measures which tend to depress the heart must, whenever practicable, be avoided.

To just what extent we can influence the natural progress of pneumonia or hasten its usual course is, however, uncertain. But we can often assist our patients through critical periods of the disease and moderate the intensity of the attack by relieving any special symptoms as they arise. It is quite possible, indeed, to render valuable aid in every stage of the affection. In the first stage the pain may be relieved and the pyrexia or delirium lessened. During the second stage the dyspnœa, heart-failure, or, in fact, any dangerous symptom that may arise, can be, at least to a certain extent, influenced. The treatment in this stage is mainly directed to promoting resolution, combating symptoms, and supporting the powers of life.

Bloodletting is therefore rarely admissible in the second stage, and all but mild laxatives are contraindicated, as it is now clearly impossible by either of these measures to remove the solid inflammatory exudate. Tartar emetic, as used by Laennec, at this stage can only be harmful. Blisters, except in those instances where resolution is delayed, should not, as a rule, be employed. The tincture of iodine, as advised by Flint, will excite all the counter-irritation desirable. Opium must also at this period be used with caution, as accumulations of mucus may be present in the bronchial tubes, and opium by checking cough increases the dyspnœa.

Expectorants are only occasionally indicated: they exert little or no influence upon the exudate, though they may be beneficial if a considerable amount of bronchitis is present. The great danger at this period is not from the lungs, but from a failure of the heart and vital forces. Hence a supporting plan of treatment is indicated: these measures should, moreover, be instituted before marked symptoms of failure of the vital powers are noticed. Otherwise it may be too late.

In the stage of resolution stimulants and tonics are most useful. Supporting measures embrace stimulants, tonics, nourishment, and sponging, the latter being not only a sedative, but a tonic to the nervous system. During the third stage convalescence is usually rapid. If resolution is tedious, occasional blisters, the iodides—especially the iodide of ammonium—and cod-liver oil will be found of service. Complications must be treated if necessary. Leeching and blistering are of doubtful utility in children, while ipecac in small doses and stimulating expectorants are of more service than in adults. In children and adults the ordinary cotton jacket answers a very useful purpose, protecting the chest from becoming chilled by exposure during diaphoresis. In young children the condition of the bowels should be carefully watched.

The diet in pneumonia should be light, nourishing, and easy of digestion. Care must be taken that too large a quantity is not forced upon a weakened stomach, lest nausea and vomiting ensue and the patient be injured rather than benefited. Anxiety to preserve the patient's strength by large quantities of nourishment has undoubtedly often led to this error of over-feeding. The diet should be regulated, as far as is possible, by the patient's own tastes and desires. Milk-punch, egg-nog, mutton or chicken broth, beef-tea, beef-juice, or beef peptonoids will in the majority of cases answer the purpose admirably. If a coated tongue, nausea, anorexia, slight jaundice, epigastric uneasiness, and constipation are present—*i. e.* symptoms of a mild gastric and duodenal catarrh—the condition will only be aggravated by forcing upon the patient nourishment which the stomach is utterly unable to digest. A mild laxative, such as calomel, with cracked ice, iced carbonated waters, or iced champagne, and liquid nourishment in small quantities every two or three hours, will usually quickly relieve the digestive disturbance and allow of larger quantities of nourishment being assimilated.

The room should be large and well ventilated, lighted to suit the wish of the patient, the temperature about 70° F., and the air kept moist by the occasional use of a steam atomizer or other means. All noise or loud talking should be interdicted, and if possible the physician and nurse be the only attendants. The patient should be assisted in all his movements, and kept in as comfortable a position as possible.

In order that our treatment of pneumonia should correspond with the modern view of its pathology, the so-called antiphlogistic method —bloodletting—as a means of cure must be abandoned, only employing it if certain definite conditions are present. For the same reason large doses of tartar emetic should no longer be prescribed, and indiscriminate blistering, especially in the early stages, must be strongly condemned.

It must not be forgotten that uncomplicated pneumonia of moderate intensity will usually, in a vigorous patient, if untreated, end in recovery. In fact, uncomplicated pneumonia in robust subjects requires little or no treatment. In asthenic cases the employment of stimulants, nourishing food, and tonics may, however, be necessary from the onset of the attack. Digitalis may be needed to stimulate the heart's action, or veratrum viride may be required to slow its beat.

Absolute rest in bed is necessary. The patient should for the necessary examinations of the chest preferably be turned from side to side rather than be raised up in bed. This is especially important if the first sound of the heart is weak and the pulse rapid or irregular. The application of leeches, wet cups, hot flaxseed poultices, or cold compresses will relieve the pain in the side. Dry cups applied to the chest will at least temporarily relieve dyspnœa and œdema; and a cotton jacket, especially if covered with oiled silk, such as is commonly employed in the large hospitals of Philadelphia, will both protect from draughts and be a source of comfort.

It has seemed to the writer that a clearer exposition of the treatment of croupous pneumonia would be possible by specifying, as has been done on the previous pages, the general considerations of treatment, followed by special lines or methods which are only to be employed when certain symptoms or conditions are present. What has already been written will suffice in the majority of instances for the management of uncomplicated cases. Often, however, our treatment must be directed against one certain symptom, as pyrexia or a condition of collapse. These we will now proceed to discuss.

Treatment of Symptoms.

Pain.—The pain which is due to the accompaning pleurisy is not uncommonly quite severe. It tends to prevent sleep, and by increasing the superficial character and rapidity of the respirations aggravates the dyspnœa and prevents the oxygenation of the blood. Either hot or cold applications are here beneficial, and the employment of cold has the special advantage, as we will see later, of controlling the pyrexia. Heat may be employed, either in the dry form, as hot cotton wadding, hot flannel cloths, or hot-water bag; or moist, as flaxseed poultices, and finally by means of cloths wrung out in hot water or turpentine stupes. Cold may be applied by means of ice-bags, compresses, or the local use of ether. The relief afforded by these methods is, however, apt to be transient, and if the pleuritic pain is severe local abstraction of blood by wet cups or leeches will often be found of benefit. If this fails, a hypodermic injection of morphine may be given at the seat of pain, or Dover's powder in doses of 5 grains may be administered every three or four hours. The employment of opiates for this condition

should, however, if possible, be avoided. Ringer[1] considers morphine injections to be rarely required unless the suffering is severe or persistent. An iced poultice, as suggested by Hare,[2] is both a neat and ready manner of applying cold for this purpose. The same author also advises a small blister applied near the painful spot or on the back near the spine. Niemeyer strongly advocates cold compresses renewed every five minutes; he says: "In almost all cases, even after a few hours, the patients assure me that they feel a material relief." Leeching, followed by hot fomentations, with the administration of sulphonal or chloral, may procure, according to Sturges and Coupland,[3] some hours of freedom from pain and induce refreshing sleep.

Cough may be an annoying symptom, especially in the first and third stages of pneumonia. When present to any greater extent than is compatible with the existing bronchitis, inhaling the spray from an ordinary steam atomizer is, as the author can testify from personal experience, of decided benefit; even keeping the air of the room moist by steam is helpful. Sturges and Coupland recommend the same means of procedure for cough as they employ for the relief of pain. Carbonate of ammonium, with minute doses of morphine ($\frac{1}{32}$ grain), is often of benefit. Stimulating expectorants should, however, be avoided unless considerable bronchial catarrh is present. Where expectoration is difficult from great viscidity of the sputum, alkalies are of service.[4]

Sleeplessness is usually due to either pain, cough, dyspnœa, or prostration, and if possible should be overcome by removing these causes rather than by the employment of narcotics. The measures and remedies suggested for the relief of pain or cough will then largely accomplish our object. Sleeplessness due to prostration is best treated by liquid nourishment given in small quantities frequently repeated, to which a small quantity of wine may be added, the wine being given not so much for its stimulating qualities as for its tonic action on the stomach and the resulting aid to digestion. Most English authors condemn the practice advocated by some of our best American writers and teachers of keeping the patient fully under the influence of opium to procure sleep, claiming that narcotism which causes prolonged sleep is unrefreshing and often followed by increased discomfort and dyspnœa. If we admit that sleeplessness is usually caused by the conditions above named, it certainly seems more rational to counteract these causes than to stupefy our patient with opium. If, however, these measures fail, chloral in one full dose guarded by digitalis, or morphine also given in one full dose, may be required

[1] *Handbook of Therapeutics*, 12th ed. p. 495.
[2] *Practical Therapeutics*, 2d ed. p. 320.
[3] *Pneumonia*, 2d ed. p. 409.
[4] Loomis, Pepper's *System of Med.*, p. 348.

Pyrexia.—Not uncommonly the pyrexia in pneumonia reaches such a height that the life of our patient is threatened, the danger coming more from the heart and train of nervous phenomena which the pyrexia induces than from the fever itself, although this has necessarily an injurious effect upon the organism. Undoubtedly, the safest and most reliable means of reducing this pyrexia or hyperpyrexia is by the external application of cold. It must, however, be borne in mind, as Liebermeister[1] has shown, that most is to be expected from cold in pneumonia when the area of lung affected is small. The value of antipyretic treatment is clearly shown by Jürgensen[2] at the Basle Clinic. Under the usual routine treatment from 1839 to 1866, in 652 cases the mortality was 25.2 per cent. From 1867 to 1871, antipyretic treatment in 230 cases, the mortality was 16.5 per cent. Fismer, comparing this same series of cases treated antipyretically with 230 patients treated by a non-antipyretic plan, shows a mortality which closely resembles the first. From 1858 to 1866, in 230 cases with non-antipyretic treatment the mortality was 26.1 per cent.; from 1867 to 1871 with antipyretic treatment the mortality was 16.5 per cent.

The objection to the cold bath—namely, that for a time at least extra work is thrown upon the heart by the contraction of the peripheral vessels due to the stimulus of cold—might seem at first to be a grave one. Practically, however, such is not the case. To counteract this, stimulants should always be given *before* and *after* the cold bath—before, for the reason just stated; after, because the temperature often continues to fall for twenty to thirty minutes after the bath has been discontinued, and great depression, or even collapse, has at times been threatened. This is well represented in a case of acute rheumatism complicated by pneumonia treated by Dr. Wilson Fox,[3] the temperature being reduced from 110° to 97.4°—*i. e.* 12.6°—in one and a half hours by a bath of forty-five minutes' duration. The patient having been removed from the bath when the temperature reached 103.6°, the temperature fell in the fifty minutes following her removal to 97.4°—*i. e.* 6.2°. External heat and brandy were sufficient to cause prompt reaction, and the patient recovered.

The temperature of the bath should be from 75° to 85° F.; it may, however, be necessary to lower this by the addition of ice or iced water. In Dr. Fox's case, for instance, the bath was reduced to a temperature of 63° F., and Jürgensen[4] has lowered the water of the bath even in children to 42.8° F. and 41° F. with good results. This reduction is

[1] *Handbook of Therapeutics*, vol. ii. p. 159.
[2] *Ziemssen's Cyclopædia*, vol. v. p. 161.
[3] *Treatment of Hyperpyrexia*, by Wilson Fox, p. 5.
[4] *Ziemssen's Cyclopædia*, vol. v. p. 163.

rarely necessary. During the bath the rectal temperature should be taken every five minutes. The duration of the bath depends upon the rapidity with which the pyrexia is lessened; usually it varies from seven to forty-five minutes. It is not often necessary to repeat this treatment more than twice or three times in twenty-four hours. In sthenic uncomplicated cases the patient should be placed in the bath when the fever reaches 103° F., and removed when the thermometer registers 100° F. In asthenic cases it is wiser to discontinue the bath when the patient's rectal temperature reaches 101° F. Under no circumstances should it be continued until the temperature reaches the normal point. In asthenic cases baths at a temperature of 77° F. to 78° F., administered for twenty to thirty minutes daily between four and seven A. M., together with the giving of quinine, has in the hands of Jürgensen produced excellent results. The cold bath has, notwithstanding its advocacy by many prominent American physicians and the lessened mortality following its use, never become popular in this country. This is probably due to the fact that it requires portable tubs and skilled attendants; like Brand's treatment of typhoid fever, it is more applicable to hospital than to private practice.

Compresses or cloths wrung out in iced water, renewed every five minutes and applied to the chest, especially upon the side where the consolidation exists, are, except when extensive bronchitis is present, among our best means for reducing pyrexia. They should be discontinued when the thermometer registers 101° or 100° F., as the temperature will often continue to fall after their removal. From a considerable experience with this method of applying cold the author can state that good results may confidently be expected from it. Heart-failure is not produced, if care be taken not to make the applications over the præcordial region; the nervous system is not depressed, but steadied; and diminished pain, with sleep, often follows its employment. The good effects are due, in the writer's opinion, not so much to any local action, as suggested by Niemeyer, but to the reduction of the pyrexia. The ice-bag as employed by Dr. D. B. Lees is an admirable manner of applying cold to the chest, and seems to act especially well with children, probably from the fact that it is easy to apply and covers in the young a large portion of the chest.

The use of the wet pack has been strongly urged by many competent observers, but it necessitates so much disturbance of the patient that while it may answer a useful purpose it is decidedly inferior to the cold bath or compresses. Before leaving the subject of cold applications it should be mentioned that reduction of pyrexia by baths, compresses, or pack should be employed with care in the weak and aged, as we are here more likely to meet with prostration and collapse during or following their use.

The majority of American physicians do not regard with favor the use of antipyretic drugs, fearing their well-known depressing action on the heart. Quinine in doses of 20 to 40 grains, repeated if necessary in two hours, has, however, the powerful indorsement of Loomis. Jürgensen gives it in the massive doses of 77 grains to an adult and 15 grains to a child under one year, and claims never to have seen any unfavorable results from such dosage. He advises these large quantities only after repeated cold baths have failed to do more than temporarily reduce the pyrexia. But as quinine in such large amounts is apt to cause vomiting, and the wished-for reduction in temperature does not occur until from four to seven hours after the administration, its use is hardly to be commended. Neither Bartholow nor Osler favors quinine as an antipyretic. Antipyrine, both on account of its sedative action on the nervous system and its well-known apyrexial properties, is advocated by J. C. Wilson.[1] The author has used antipyrine in 5-grain doses guarded by 3 grains of sulphate of quinine, repeated if necessary every half hour until three doses were administered, and has in a limited number of cases seemed to obtain the effects of the antipyretic without its usual depressing results.

Dyspnœa.—The dyspnœa which occurs in pneumonia, while in the main due to the large portion of pulmonary structure rendered useless by the inflammatory exudate, may be, and often is, aggravated by other causes. The pain of pleurisy by making the respirations shallow increases their frequency. Emphysema or cardiac dilatation if present adds greatly to the distress, and abdominal distension, from the presence of flatus or liquid, may increase the already existing shortness of breath. In cases in which the pleuritic stitch aggravates the dyspnœa, the treatment of this pain, as already outlined in a previous page, should be followed. If extreme dyspnœa, threatening asphyxia, coincides with irregular cardiac action, weak pulse, and decided blueness of lips and finger-tips, together with the physical signs of extensive pulmonary œdema and congestion, bleeding[2] from the arm to the extent of eight to twelve ounces will afford at least temporary relief and give an opportunity for the exhibition of stimulants. Turpentine stupes or mustard applied to the chest will often be found of benefit. Cold compresses are strongly urged by Niemeyer[3] for the relief of dyspnœa, and in the croupous pneumonia of children they are especially recommended by Ziemssen. Dry cups have in the hands of the writer often given marked relief. Ethyl iodide, 20 to 30 minims dropped on a handkerchief placed lightly over the mouth and inhaled, is strongly advocated by Bartholow; and strychnine, both on account

[1] *Medical News*, Philada., Dec. 20, 1890.

[2] Loomis, in Pepper's *System of Medicine*, p. 346.

[3] *Handbook of Practical Med.*, p. 185.

of its stimulating power upon the respiratory centre and its tonic action on the heart-muscle, is advised by Hare.[1]

Heart Failure.—As the chief danger of pneumonia lies in failure of the heart, all drugs or measures which tend to depress this organ should be as far as possible excluded from the treatment. Absolute rest and quiet in bed must be insisted upon, and the patient should be kept upon a light, nourishing, and easily-digested diet, given at frequent intervals. Heart failure in pneumonia, according to the observations of the author, occurs under two conditions: First, by a paralysis of the right heart, caused by the solidification in the lung, overdistension of the pulmonary artery and vessels, and passive congestion of the venous system, the formation of heart-clot, and the arrest of the heart in diastole. Secondly, a gradual failure of the heart as a whole, most apt to occur in cases in which the infection is intense, as shown by hyperpyrexia, marked nervous phenomena, great prostration, and a general adynamic condition. These two conditions can easily be distinguished, not only by their symptoms, but also by carefully studying the cardiac sounds. When paralysis of the right heart is threatened, we have, in addition to the signs of pulmonary and venous engorgement, a muffled first and poorly-accentuated second sound, heard over the area of the pulmonary valves. When the heart as a whole is failing, we have, in addition to the nervous phenomena, *all* the heart-sounds weakened. The treatment of both these conditions is in many respects the same. Alcoholic stimulants judiciously applied are undoubtedly the best means at our disposal for combating both these forms of cardiac failure. But alcohol must be given with discretion: the first sound of the heart is a much better indication for or against stimulation than the pulse. Its use must be governed by judgment, and it should not be given as a routine practice.

The pneumonia of drunkards and of the aged, when great prostration is present or collapse is threatened, is a condition in which stimulants are not only useful, but demanded. Many sthenic cases require little or no stimulation throughout the entire illness. Large quantities of alcoholic stimulants may, however, be necessary to ward off impending collapse, 20 ounces having been given during one night, by Dr. Wilson Fox, with marked benefit in a case in which collapse was threatened, following reduction of hyperpyrexia by the cold bath. When failure of the right heart is imminent, bleeding from the arm, 10 to 12 ounces, will often give marked temporary relief. Dr. Darrach[2] advocates the use of nitro-glycerin. This drug, or potassium or sodium nitrite, is also strongly urged by Andrew H. Smith,[3] who claims

[1] *Practical Therapeutics*, 2d ed. p. 535.

[2] *Trans. Philada. Coll. Phys.*, 3d Series, vol. x. p. 186.

[3] *American Journ. Med. Sciences*, Oct., 1890.

that in those cases in which the right heart is exhausted from overwork, caused by the accumulation of blood in the venous system, nitroglycerin, by its well-known action of dilating the blood-vessels, causes a more even distribution of the blood in the arteries and veins, and will, temporarily at least, be of benefit to the right heart. Dr. Smith claims excellent results from doses of 1 drop of a 1 per cent. solution, administered every fifteen to thirty minutes. The remedy is certainly worthy of extended trial, especially as much is claimed for it in a condition in which the physician often clearly perceives his own helplessness.

Digitalis in these cases, in my experience, does little or no good. Sturges and Coupland have not found digitalis efficacious in removing dyspnœa, cyanosis, and other signs of auricular distension. Bleuler gave digitalis, $\frac{1}{2}$ drachm of the powder daily, getting in some instances the toxic influence of the drug: his results were decidedly unfavorable. Digitalis is, however, in the writer's opinion, of decided benefit in those cases in which the heart as a whole is failing. Given in 5-drop doses every three or four hours, especially if combined with $\frac{1}{60}$ grain of strychnine sulphate four times a day, it will steady the heart, slow the pulse, change the character of the heart-sounds, and produce its well-known tonic action on the heart-muscle.

Diarrhœa.—Diarrhœa occasionally develops during pneumonia. If appearing early in the case, it is usually of a mild character, and is easily controlled by strict attention to diet and the internal administration of opium or astringents. Developing at the time of crisis, it will, as a rule, exhaust itself in a few days, and requires little or no treatment. In infants and young children vomiting and diarrhœa are not infrequent at the beginning of the attack, and in such cases special attention should be given to the diet; if nursing increases decidedly the dyspnœa, it may be wise to give the child, temporarily at least, peptonized milk, beef-juice, or beef peptonoids. Dover's powder in suitable doses or bicarbonate of sodium, with small doses of deodorized tincture of opium, will usually be all that is required. Low forms of pneumonia in the aged are occasionally accompanied by diarrhœa; astringents answer here the best purpose: opium must be used with caution.

Delirium.—Active delirium is rather unusual in uncomplicated pneumonia of adults; it is not uncommon in children. Delirium is not infrequently associated with disease of the kidneys or meningitis, and our treatment should under these conditions be directed to the meningeal or renal disease. A history of alcoholism can often be obtained in these cases. Absolute quiet, a darkened room, and cold applications to the head will suffice to relieve the milder cases. Persistent delirium will require stimulants in small quantities frequently

repeated, and a full dose of either chloral or morphine. In inebriates chloral, digitalis, and free stimulation have given the best results. Delirium in adynamic cases or in the aged demands prompt and free stimulation. Professor H. C. Wood[1] considers musk, 10 to 15 grains suspended in mucilage and given by rectal injection every six hours, to be very useful in these adynamic cases, especially if wild or muttering delirium be present. Opium must in these cases be given with caution.

Stimulants.—The question of stimulation is one on which a fair unanimity of opinion prevails. The necessity for the use of stimulants is often evident, especially in the aged, when great prostration exists. Stimulation should not be delayed until the vital powers are greatly depressed, and except in cases of sudden collapse it is wiser to begin with small quantities, gradually increasing the amount if the indications warrant. Hyperpyrexia is to be treated by stimulants only when other symptoms demand it. During convalescence it is often of service to counteract the resulting weakness. Alcohol, given either as brandy or whiskey, is usually the best stimulant, but if nausea or vomiting is present iced champagne may be preferable. When symptoms of indigestion are present, especially if the indications for stimulants are not marked, a light wine, as dry sherry, given with the nourishment acts not only as a mild stimulant, but also as an aid to digestion. Its efficiency under these circumstances is often increased by a dose of 5 to 7 grains of calomel, with 10 grains of bicarbonate of sodium given a few hours beforehand. Carbonate of ammonium has been given for the purpose of preventing heart-clot; its use has not, however, been followed by any great measure of success. Camphor, musk, and other so-called stimulants have their advocates, but cannot, in the writer's opinion, be depended upon with any degree of confidence.

Inhalations.—Inhalations have been employed with a fair degree of success in the treatment of pneumonia, and are of undoubted assistance in the treatment of dyspnœa, venous congestion, and sleeplessness. Oxygen, either pure or in combination, is the gas which is deservedly the most popular. In regard to inhalations, it must be borne in mind that all remedies employed are carried by the respired air to their destination, coming in contact with both healthy and diseased structures; therefore, all irritant inhalations are contraindicated. Full inspirations with the mouth wide open offer the best opportunity for their entrance. J. C. Wilson[2] employs a mixture of 1 part oxygen with 2 parts of nitrogen monoxide. Bartholow[3] claims antiseptic properties for iodide of ethyl, and that decided improvement in cough, bronchial irritation, and expectoration follows its use: the method of its administration is

[1] *Therapeutics*, 7th ed. p. 115. [2] *Medical News*, Philada., Dec. 20, 1890.
[3] *Amer. Journal Med. Sciences*, Nov., 1890.

given on a previous page. An equal mixture of chloroform vapor and atmospheric air is advised by Professor M. J. Oertel:[1] it has in his hands not only relieved pleuritic stitch, but also diminished the number and increased the fulness of the respirations.

Antiseptic Treatment.—The treatment of pneumonia by antiseptics—*i. e.* the specific treatment—has not been regarded with much favor by the medical profession. Benzoate of sodium, iodine, the salicylates, iodide of ethyl, and carbolic acid are especially recommended as antiseptics. Of these the results obtained from iodine are the most striking. The treatment of pneumonia antiseptically has, however, as yet not been conducted on a scale sufficiently large to warrant a positive opinion being expressed in regard to its usefulness. That numerous agents have the power to destroy pathogenic organisms is certain, but as yet in the treatment of pneumonia no means have been devised of bringing a sufficiently powerful germicide into such relationship with the infecting organisms as to abort, shorten, or mitigate the severity of the pneumonic process.

Antiphlogistic Treatment.—Tartar emetic in large doses as a part of the old antiphlogistic régime is to be avoided; it tends by depressing the heart to render it less able to endure the strain which usually falls upon this organ during the progress of pneumonia. Veratrum viride, although still advocated by many prominent English and American physicians, is to be avoided for the same reasons as tartar emetic. Its use is, however, free from the objection of causing the intense nausea and vomiting (unless administered in very large quantities) which follow the giving of tartar emetic in doses sufficient to cause a decided reduction in the circulation. It is comparatively free from danger, and may be used when in the early stage of sthenic cases marked arterial excitement is present. Its utility ceases when exudation has taken place. Aconite is open to the same objections as veratrum viride; its use is also not unattended with danger, since it is a powerful cardiac depressant. The writer thoroughly agrees with Loomis and J. C. Wilson, who claim that its depressing action on the heart should prevent its employment in the early stage of even sthenic pneumonia.

Treatment of Convalescence.—Convalescence is, as has been previously stated, usually complete and rapid. Tonics, such as iron and quinine, with a supportive and mildly stimulating plan of treatment, will in the majority of cases be all that is required to complete a cure. In asthenic cases and in the aged, prostration, collapse, and subnormal temperature may follow the crisis. These untoward symptoms are, however, unusual, especially in cases in which a supportive and stimulating plan of treatment has been followed.

[1] *Von Ziemssen's Handbook of General Therapeutics*, p. 328.

Asthenic cases and the prostration of the aged are to be met by prompt stimulation, concentrated nourishment, and tonics. Collapse and subnormal temperature demand, in addition to the above, the application of external heat and the hypodermic use of whiskey or ether. Resolution may not be rapidly established, and impaired percussion resonance, with broncho-vesicular breathing and subcrepitant and crepitant râles, may remain at the seat of former consolidation. These physical signs usually disappear in from four to six weeks under proper hygienic, dietetic, and tonic treatment. Flying blisters, iodine locally, or the iodides internally, especially the iodide of ammonium, will tend to hasten clearing up of the lung. If fever persists, resolution be delayed, and improvement in the general health is not noted, tubercular disease should be thought of, and patients in this condition should be protected as far as possible from tubercular infection. When wasting and night-sweats are present with the above symptoms, tubercular phthisis has probably developed and treatment appropriate to that condition should be instituted.

Venesection.—The subject of bloodletting has already been referred to incidentally in the previous pages. Venesection has, however, occupied such a prominent place in the history of pneumonia that a discussion of its treatment would be incomplete were bloodletting not carefully considered. Bleeding as a routine plan of treatment—that is, bleeding for pneumonia—is, in the light of modern pathology and the existing belief of its causation, not only useless, but harmful. There is no doubt that the pendulum of medical opinion in regard to bloodletting has swung from one extreme to the other, and that the almost universal condemnation of bleeding at the present day will be shortly corrected. Venesection is, moreover, as Flint[1] observes, especially applicable to the treatment of inflammation affecting the pulmonary organs in consequence of the close relationship between the heart and lungs. The chief advantage of bloodletting is that the results are rapidly obtained. At the present day we bleed only to gain time or to combat certain conditions, exactly as we might give a hypodermic injection of morphine to relieve pain after having employed milder means without success. The improvement which follows its use is usually of short duration.

In sthenic cases when the symptoms of acute pulmonary congestion are intense—*i. e.* dyspnœa threatening asphyxia, venous congestion, and hard, incompressible pulse—*early* bleeding from the arm, 8 to 12 ounces, often gives relief and seems to exert a favorable impression on the progress of the case. In the second stage bleeding is admissible only when asphyxia is threatened from venous congestion, and the abstraction of 8 to 12 ounces of blood affords time for the exhibition

[1] *Practice of Medicine.*

of stimulants. Extreme dyspnœa, however, when accompanied by great prostration, contraindicates venesection. It is not without danger in the aged when prostration exists, and if kidney disease is present, bleeding increases the chance of an unfavorable termination. Protracted convalescence often follows its use. The indications are high fever, full, resisting pulse, urgent dyspnœa, and robust constitution; the contraindications are moderate fever, rapid and weak pulse, feeble constitution, and old age. Pneumonia as a complication of the continued fevers is to be treated by supportive measures, not by bleeding. Venesection is rarely if ever admissible in young children, even in the early stage.

Abortive Treatment.—The so-called abortive treatment of pneumonia is received, and justly so, with little faith by the medical profession. There is nevertheless considerable evidence to prove that one full dose, 10 grains, of calomel, or active catharsis by salines, if employed soon after the initial chill, temporarily improves the general condition of the patient, and possibly even exerts a favorable impression on the subsequent course of the disease. Early in the disease quinine, given in large doses when hyperpyrexia is present, has seemed to the author to be of more than temporary benefit. The writer has had no experience with the hypodermic use of pilocarpine in this connection, but would hesitate to employ it lest depression should follow its use.

Complications.—The many and varied complications of pneumonia cannot be discussed in this article. Two conditions will be briefly considered—the secondary extension of the pneumonic process, and the development of solidification in the opposite lung. These complications are of the utmost gravity, and positively demand a supportive and actively stimulative line of treatment. The treatment of other complications will be determined by the fact as to whether it is the pneumonia or the coexisting disease which is threatening the life of the patient. When the danger lies upon the side of the coexisting affection, the treatment should be directed to removing or counteracting that condition. If the pneumonia, notwithstanding the complication, is paramount, the following of a symptomatic method will give the best results. The consideration of the sequelæ of pneumonia—phthisis, abscess, and gangrene—does not come within the scope of this paper, and accordingly they will not be noticed.

Mortality Statistics.—It is not difficult to understand the unreliabilty of most mortality statistics as regards any special line of treatment in pneumonia, if we remember, on the one hand, the many phases of the disease, and the fact that it is self-limited and will often end in recovery without treatment; on the other, that in many instances

the lesions found post-mortem are incompatible with life, and that Rasori and his pupils have proven, by removing ten pounds of blood from a single patient, that some cases will recover notwithstanding the means employed for their relief. The statistics of any treatment to be of value should embrace an accurate description of the condition of the patient before, during, and after its employment.

The danger in drawing conclusions from limited statistics is clearly shown by Osler[1] in the following table, collected from the reports of the Pennsylvania Hospital of Philadelphia:

Years.			Years.		
1845–46–47—mortality	16	per cent.	1848–49–50—mortality	37.9	per cent.
1855–56–57— "	25.4	"	1858–59–60— "	21.2	"
1865–66–67— "	24.1	"	1868–69–70— "	22.8	"
1875–76–77— "	39.2	"	1878–79–80— "	32.7	"
1885–86–87— "	36.1	"			

If one considers only the table on the left, it might easily be supposed that, as Dr. Hartshorne declares, under the older plans of treatment the mortality was less than under the present expectant method. But a glance at the figures in the right-hand column immediately disproves this, the mortality of 37.9 per cent. in 1848–49–50 under the older methods being almost as great as that of any period cited.

Statistics, however, which relate only to a certain condition, as asthenia, treated by certain means, as alcohol or digitalis, or to a definite symptom, as pyrexia, treated by cold sponging or antipyretic drugs, are undoubtedly of great value. By this method it is possible by comparison to judge at least approximately of the relative merits of the means employed.

CATARRHAL PNEUMONIA.

It is evidently impossible to formulate any exact rules for the treatment of catarrhal, lobular, or broncho-pneumonia, as the disease varies greatly in onset, symptoms, course, and duration. The condition is one of local inflammation, not a general or systemic disease. It is usually bilateral, and is always accompanied by atelectasis of greater or less extent, this collapse being mainly produced by the existing bronchitis obstructing the bronchioles, and the inherent elasticity of the air-vesicles. The inflammatory process cannot be checked by an abortive plan of treatment, and, as in croupous pneumonia the best results are found to follow an expectant symptomatic method, so

[1] *Trans. Philada. Coll. Phys.*, 3d Series, vol. x. p. 188.

in catarrhal pneumonia to nourish the patient, remove all source of external irritation and worry, and promptly treat all dangerous conditions or symptoms as they arise is the method which experience proves most worthy of adoption.

The best criterions of the patient's condition from day to day are undoubtedly, as Sturges and Coupland [1] aver, the pulse, prominence of attending symptoms, as vomiting, diarrhœa, and wasting, the rapidity of respiration, and the cough. The physical signs and temperature are often misleading.

Since broncho-pneumonia is a local disease due to a pre-existing local cause, it is of the first importance to remove this cause. In considering the prophylactic treatment of this disease, and remembering its connection with bronchitis, it becomes of the utmost importance to study carefully the different conditions, either local or systemic, under which catarrhal pneumonia develops.

Recurrent attacks of bronchitis predispose to broncho-pneumonia. It is common after all infectious diseases with which bronchitis is associated, such as whooping cough, measles, diphtheria, influenza, scarlet fever, and variola; while the inhalation of irritating gases, as well as the presence in the bronchi of foreign bodies, undoubtedly favors its development. Among the chronic diseases which stand in a causative relationship are rickets, syphilis, and scrofula.

Bronchitis in children under three years of age, and in the aged, especially if occurring under bad hygienic or dietetic conditions, must be carefully watched, lest catarrhal pneumonia develop. Bartels insists especially on these factors as causative.

When we consider the fact that in catarrhal pneumonia the death-rate is higher than in the croupous variety, the importance of both prophylactic measures and prompt treatment after the disease has developed is evident.

Many varieties and forms of catarrhal pneumonia have been described by observers. The division into acute and chronic is, however, sufficient for our purposes. The symptomatology and physical signs may vary much in these two forms, the slow course, involvement of large area of lung-tissue, and moderate febrile reaction in the chronic variety being in marked contrast to the rapid and superficial respiration, high and irregular fever, and great restlessness of the acute form. These differences are present both in infant and adult life. The acute form runs its course usually in from two to four weeks; chronic catarrhal pneumonia may last for months. In the treatment of this affection it must be remembered that the danger is in inverse proportion to the duration of the attack and in direct proportion to the physical condition of the patient and the extent of lung involved.

[1] *Pneumonia*, p. 247.

The prophylactic treatment consists mainly in good hygienic surroundings and appropriate diet; the avoidance of all unnecessary exposure to wet, damp, and draughts; a daily bath, and the wearing, especially in children, of close-fitting woollen under-clothing. When bronchitis has developed the patient should remain in a well-ventilated room, the temperature being from 68°–72° F., and the air kept moistened by steam. If the bronchial catarrh is mild at the onset, Dover's powder, a warm bath, and a saline with 12 grains of sulphate of quinine for an adult in twenty-four hours, will usually be all the treatment required. If the foregoing means are not successful, mild diuretics and diaphoretics, inhalation of steam, the application of dry cups, and 5 grains of chloride of ammonium every three hours will usually suffice.

All that the term "good nursing" in its broadest sense implies aids materially in producing rapid convalescence. The patient should be made comfortable in bed, be bathed every day, and, if the sufferer be a child, not frightened, but as far as possible amused and his confidence gained. If the latter is not accomplished, little aid is obtained from the results of physical examination. Rest in bed is imperative, and during the entire course of the disease the patient's position should be frequently changed, as hypostatic congestion, œdema, and collapse are thus often prevented.

When catarrhal pneumonia has developed, our treatment is mainly directed to supporting the strength of the patient, promoting expansion of the lungs, and controlling the pyrexia. At the beginning of the attack calomel in fractional doses with bicarbonate of sodium is often useful, especially in children, in whom nausea and vomiting are apt to be present. Quinine in full doses is undoubtedly a remedy of great value in both the acute and chronic forms of the disease. It is of special service in the young by controlling the pyrexia and pulse, sustaining the system, and possibly limiting the extension of the pneumonic process. Chloride of ammonium is of undoubted benefit, especially after the acute stages of the disease have passed. If asphyxia is threatened from an accumulation of bronchial secretion, an emetic often gives prompt relief.

As death in catarrhal pneumonia, especially in children and the aged, is not infrequently due to asthenia, stimulants are often required from the onset of the attack. The bowels should be moved every day, gentle laxatives, as compound liquorice powder or citrate of magnesia, being useful for this purpose. Local counter-irritation with mustard, tincture of iodine, or a mildly irritating liniment is of benefit.

The room should be large, well ventilated, and the light regulated according to the wishes of the patient. The temperature should range from 68° to 72° F., and the air be moistened by the vapor from a

steam atomizer. The clothing should be adapted to the season, and care be taken that the patient is not subjected to draughts. A light cotton jacket protects the chest from changes in temperature and promotes diaphoresis; it is especially of benefit in the case of children. Throughout the disease light, nourishing, and easily-digested food, such as milk, broths, beef-tea, and beef peptonoids, should be given in small quantities frequently repeated. While an abundance of nourishment is called for, the patient should not be overfed, lest the digestive powers be overtaxed, vomiting result, and the general asthenic condition be increased.

If urgent dyspnœa exists in a very young child, the little patient is no longer able to nurse properly, and the effort to do so may, by increasing the already-existing shortness of breath, provoke vomiting. Cow's milk with cream and barley-water and a few grains of sugar of milk may be given with advantage under these circumstances.

The treatment of the bronchitis, by reason of its close connection with catarrhal pneumonia and collapse, is of decided importance. When in the first stage of the disease the cough is excessive, out of proportion to the amount of coexisting bronchitis, and tends by inducing nausea, vomiting, and loss of sleep to diminish the vital forces of the patient, opium in combination with ammonium carbonate, in doses suited to the age and condition of the patient, should be employed. When, however, the inflammatory process in the lung has fully developed, opiates must be used with caution, lest by obtunding sensibility reflex cough should be checked, and, the secretions collecting in the bronchial tubes, the already existing dyspnœa be aggravated. Many authors, among whom may be mentioned Loomis,[1] claim that opium should under no consideration be given. Certainly after consolidation is completely established opiates by checking cough favor pulmonary collapse. Their employment in the early stage of a bronchopneumonia to relieve the excess of cough has, however, in the hands of the writer been followed by good results.

The chloride of ammonium, combined with syrup of senega or syrup of squill, favors expectoration and tends to prevent collapse of the lung-structure. It may occasionally be necessary, owing to the abundance and viscid condition of the collected mucus in the bronchial tubes, to administer an emetic. The well-known combination of alum and ipecac here answers a useful purpose, and is, in the opinion of the writer, followed by less depression than either sulphate of zinc or the hypodermic injection of apomorphine. The latter when used is given in doses of $\frac{1}{12}$ grain to an adult, and repeated if necessary in twenty to thirty minutes. Emetics must, however, be used with care in all asthenic cases, as marked depression or collapse may follow their

[1] *Practice of Medicine*, p. 108.

employment. When excessive bronchial secretion with suppressed or feeble cough is present, carbonate of ammonium with syrup of senega is often of benefit.

The inhalation of steam, by increasing the secretion of the bronchial mucous membrane and diminishing the viscid character of the sputum, will facilitate expectoration and temporarily relieve the dyspnœa. In the later stages, as well as in the chronic form of the disease, oil of turpentine as a stimulating expectorant seems by common consent to be the remedy which is most often followed by good results. It may be given in 5-drop doses every four hours.

Inhalations of oxygen often give marked relief when symptoms of asphyxia are present. Strychnine, both on account of its stimulating action upon the respiratory centre and its tonic effect upon the muscles of respiration, is also beneficial. Jürgensen[1] recommends highly in this connection the use of baths at a temperature of 77°–86° F., the patient remaining in the bath from twenty to thirty minutes. After he is placed in the bath 10 to 20 quarts of water are poured over him from a moderate height. The affusion must be rapid, and the neck, back, and chest should especially be douched. The water used may be reduced in temperature to a few degrees above the freezing-point. The same author also claims excellent results from the use of a stream of water directed against the back of the head over the region of the medulla oblongata. Deep inspirations with increased strength of cough are claimed to be induced by this procedure, even when marked symptoms of carbonic-acid poisoning are present.

Notwithstanding the good results claimed to follow the employment of the bath and douche in dyspnœa, it has never been generally adopted as a method of practice. If, however, its further use confirms the claims of Jürgensen, Bartels, and others, it will be of undoubted aid in the treatment of a dangerous condition. It must not be forgotten that stimulants should always be administered before and after the bath. The application of leeches in children and the employment of venesection in adults will often, as in croupous pneumonia, be followed by marked relief. Inhalations of steam and thorough dry cupping of the chest are also useful adjuncts to our treatment of rapid and superficial breathing.

During the course of a catarrhal pneumonia the state of the circulation varies greatly. The pulse, as a rule, is rapid even during the remission of fever; in children a pulse of 160 to 200 beats per minute is not uncommon. A small and compressible pulse is always an omen of danger. The muscular structure of the heart, while not suffering to the same extent as in croupous pneumonia, is still to some extent liable to fatty and granular change. Failure of the right side

[1] *Ziemssen's Cyclopædia*, p. 231.

of the heart is threatened when atelectasis is present in a marked degree. Undoubtedly the best means we possess to counteract heart failure in all stages of the disease, no matter what its cause, are bold stimulation, proper food, and quinine given in tonic doses. As regards the use of stimulants, they should be commenced early, and given in sufficiently large quantities to overcome the failure of the vital forces which often develops early in the disease. The rapid pulse, and in asthenic cases its weak and irregular action, and the tendency to degeneration of the heart-muscle, are conditions in which whiskey and brandy are especially useful. When failure of the right heart is threatened, prompt stimulation offers, in the writer's opinion, the only hope to the patient. The subcutaneous injection of 15 to 20 minims of ether, repeated three or four times daily, has undoubted power to increase the strength and volume of the pulse and diminish the number of respirations. In the adynamic form of catarrhal pneumonia ether is also of benefit.

Young infants may be given 10 to 20 drops of whiskey every three or four hours, and the quantity should be gradually increased if the condition of the pulse, respiration, or dyspnœa demands it. Children indeed often take large amounts with decided benefit. The quantity to administer must be determined by the necessities of each case. Alcoholic stimulation is also useful when failure of respiration is present, and is a valuable adjunct to treatment when marked nervous phenomena exist. Champagne is often beneficial in adults, especially if nausea and vomiting are present; children do not take it well.

Tonics and stimulants are to be resorted to in cases in which debility is manifest or when resolution is delayed, even if the fever has declined or if evidence of a typhoid state develops. Under these conditions the vital forces may by nourishment, alcohol, and tonics be sustained and strengthened, and time gained for the breaking down, absorption, and expectoration of the inflammatory exudate. Quinine in doses suited to the age of the patient is here the best tonic.

In that form of catarrhal pneumonia which is due to passive congestion or hypostasis, and in which debility plays an important rôle as a causative factor, frequent changing of the position is of benefit and quinine and alcohol demanded. According to Bartholow,[1] turpentine is also a most useful stimulant when the vital powers are depressed and the peripheral circulation is feeble. No attempt should be made to lower the temperature, either by drugs or the external application of cold, without the previous administration of either whiskey or brandy.

The treatment of the fever in catarrhal pneumonia, owing to its remittent character, does not often demand those vigorous measures which are called for in the croupous form of the disease. Sulphate

[1] *Materia Medica and Therapeutics*, 6th ed. p. 722.

of quinine has decided power in such cases, and while the fever persists may be given in full doses. Rapmund[1] recommends it highly in the treatment of pyrexia in lobular pneumonia. If the nervous phenomena are not marked and only moderate dyspnœa be present, quinine in decided doses or 5 grains of antipyrine, guarded by 3 grains of quinine, will often be of marked benefit. Antipyrine, according to Pribram,[2] positively diminishes the frequency of the respirations. It seems to act especially well in children. If these means fail, external applications of cold, either by cold bath, compresses, or cold douche, as advised by Jürgensen, to which special attention has been called upon a previous page, are, if properly carried out, undoubtedly the best means of combating this dreaded symptom.

It seems strange that American physicians, who are usually so prompt in giving all therapeutic measures a thorough and complete trial, should have so largely neglected, and even condemned without adequate experience, these measures of reducing pyrexia. Collapse has undoubtedly been caused by the incautious use of cold, especially in feeble children, but with care and the giving of stimulants, which in the writer's opinion is very important, it is almost always possible to prevent it. The ice-bag, as advised by Dr. D. B. Lees,[3] seems to be especially useful in the broncho-pneumonia of children. Goodhart strongly recommends its use. Continued high temperature demands, according to Bartholow,[4] the use of quinine and digitalis. Five grains of quinine and $\frac{1}{4}$ grain of digitalis are advised three times a day for a child two years of age.

Various nervous symptoms, as headache, restlessness, drowsiness, delirium, or convulsions, are not uncommon in the early stages, especially in children. Careful nursing, soothing words, and a familiar face at the bedside will often suffice in the milder cases. If in addition to the nervous phenomena high fever is present, either a sponge bath, the temperature of the water being from 72° to 76° F., or the application of cold compresses to the head, will often relieve the symptoms to a remarkable degree and be followed by refreshing sleep.

It must not be forgotten that in order to obtain the full benefit of cold affusions to the head the hair must be kept thoroughly wet, otherwise the head is, as it were, protected by a shield and the full benefit from the wet compresses is not obtained.

Chloral given by the rectum in doses of 3 grains to a child three years of age, or a combination of chloral and bromide, will, as a rule, promptly control convulsions and lessen delirium. If the heart's action is feeble or depressed, it is well to guard the use of chloral with alcoholic stimulants. Musk suspended in mucilage and given by rec-

[1] *Deutsche Klinik*, 1874, p. 51.
[2] *Prager. med. Wochenschrift*, 1884.
[3] *Lancet*, 1889, ii. p. 890.
[4] *Practice of Medicine*, p. 349.

tal injection is considered a very useful remedy by H. C. Wood in adynamic pneumonia when wild or muttering delirium is present. When the delirium is extremely active and restless, Pepper[1] advocates the hypodermic use of hyoscyamine in doses of $\frac{1}{80}$ to $\frac{1}{100}$ grain for an adult. Opium should not, in the opinion of the writer, be used to control the nervous symptoms, as in the doses required for this purpose sensibility is so far blunted that cough is lessened to a dangerous degree, and the tendency to dyspnœa with asphyxia increased.

Before considering the means to be employed to overcome the condition of pulmonary collapse, it is necessary to understand the causes operating to produce this condition. As is insisted upon by Bartels, collapse is especially liable to develop in those parts of the lung which under normal conditions display the least motion—that is, the lower and posterior portions. The diminution of the calibre of the bronchi, due to the inflamed condition of its lining membrane, and the failure of the superficial respirations of the patient to expand the lungs thoroughly, do not allow the inherent elasticity of the air-cells to assert itself, and the capacity of the alveoli diminishes. The accumulation of mucus and the partly occluded condition of the bronchi cut off the entrance of air to a certain portion of pulmonary tissue, and the small amount of air which remains disappearing, partly through the violent expiratory efforts of cough and partly by pressure, collapse takes place. It is therefore evident that asthenic conditions by favoring the accumulation of mucus in the bronchi, an immovable decubitus by increasing the tendency to hypostatic congestion and œdema, and high fever by increasing the rapidity and superficial character of the respirations, predispose to atelectasis.

Remembering, then, the conditions and causes upon which collapse depends, its treatment becomes evident. The frequent changing of the patient's position, with the application of dry cups, will clearly be of benefit in counteracting the collapse due to hypostatic congestion and œdema. Strychnine will be found useful when failure of the respiration is present, and the preparations of ammonium, with perhaps the cautious use of emetics, will be found most serviceable in removing the accumulations of thick, viscid mucus. The external application of cold by the bath, compresses, or sponging will control the fever, and the use of a stream of water directed against the back of the head, as recommended by Jürgensen, will be of benefit by diminishing the rapidity and increasing the fulness of the respirations.

One of the most important duties of the physician in the management of catarrhal pneumonia is the prevention of any gastro-intestinal disorder, and its treatment should it occur. The ability to take and digest nourishment in suitable amounts aids materially in sustaining

[1] *System of Medicine*, p. 372.

the vital forces, in preventing heart and respiratory failure, and in the avoidance of collapse. For the relief of the nausea and vomiting which are frequently present early in the disease the patient should be kept at absolute rest; iced carbonated waters, as plain soda-water, or in adults iced champagne, should be administered; small pellets of ice allowed to dissolve in the mouth; a mild mustard poultice applied to the epigastrium; and calomel in fractional doses, with 1 to 2 grains of bicarbonate of sodium, should be dropped on the tongue every two hours. The nourishment may consist of beef-juice, beef peptonoids, peptonized milk, or milk and lime-water. In severe cases it may even be necessary for twelve or twenty-four hours to stop all nourishment by the mouth and give nutrient enemata. The vomiting which accompanies the effort of nursing when dyspnœa is present in children has been referred to on a previous page. Diarrhœa when present is best treated by astringents.

The treatment of collapse must be prompt and decided. The hypodermic use of whiskey or brandy, with the external application of heat, often exerts a favorable impression on the pulse. Stimulating applications to the chest by mustard poultices or by liniments excite deeper and fuller respirations, and the alternate hot and cold douche often aids materially in arousing the patient, stimulating the cough, and improving the character of the breathing. The collapse which occasionally follows cold applications is best treated by enemata of whiskey and external applications of heat. In conditions of profound collapse remarkable results have been reported from the subcutaneous injection of ether.

Catarrhal pneumonia is usually followed by marked debility, and recovery takes place slowly. During convalesence careful nursing is necessary to prevent relapses, slight exposure often being sufficient to produce a return of the bronchitis, with a resulting broncho-pneumonia, and possibly the development of phthisis, especially in those who present a tubercular family history. Counter-irritation by tincture of iodine, dry cups, or a few small blisters, with the internal administration of ammonium iodide, will be of service in promoting resolution and absorption. During this period quinine, iron, and alcoholic stimulants will be found most useful, tending by improving the general condition to shorten convalescence. If in those cases in which the inflammatory process has pursued a subacute course convalescence is retarded and emaciation is marked, iron, cod-liver oil, the hypophosphites, and free stimulation are indicated. In all subacute and chronic cases the nutrition of the patient is of the first importance. Emetics during convalescence can only do harm by disturbing digestion. Much good is derived from the administration of oil of turpentine, eucalyptol, and copaiba at this stage of the disease. After convalescence

is established a change of residence to a high dry climate by the expansion and unfolding of the lungs resulting from the respiring of rarefied air will tend to hasten the cure.

The most frequent complications of catarrhal pneumonia are bronchitis, laryngitis, and pleuritis, which are really parts of the pneumonitic process, and are to be treated only when they assume such a degree of importance as to necessitate their control. The most important of the sequelæ is tubercular phthisis. As has been previously pointed out, it is especially liable to develop in those cases of subacute and chronic broncho-pneumonia in which a tendency to tuberculosis exists. Emphysema, and less often gangrene of the lung and pneumothorax, have been noted as sequelæ. The treatment of the complications and sequelæ does not, however, come within the scope of this article. The same broad rule applies to their treatment as exists in the croupous form of the disease. Only those complications or sequelæ which from their gravity are militating against the recovery of the patient should be treated.

Unless to meet some special indication, poultices are seldom useful. It is difficult in their frequent removal to avoid exposure of the chest; they fatigue the patient by their weight; and the restlessness of children renders it almost impossible to keep them in position. The ordinary cotton jacket covered with oiled silk is a much better and more comfortable protective. Counter-irritation with dry cups, tincture of iodine, mild mustard poultices, or turpentine stupes can, if the jacket is worn, be applied with facility to any portion of the chest. In connection with the poultices, mustard foot-baths may also be employed. The action of the skin may be increased and restlessness relieved by tepid sponge-baths, followed by friction. At the onset of the attack a large mustard plaster to the chest, allowed to redden the skin, has in a few cases seemed to the writer to be of decided advantage, while the tincture of iodine or an occasional blister is most useful during the stage of resolution. The pleuritic stitch can often be relieved by the application of hot flaxseed or linseed poultices.

Large blisters should never be employed. Venesection is rarely admissible; by reducing the vital forces of the patient and lessening the strength of the respiratory muscles it increases the tendency to pulmonary collapse. The application of leeches to the chest, with the giving of stimulants, is, however, strongly advocated[1] when extreme dyspnœa with shallow, ineffectual respirations is present, tending to pulmonary engorgement and collapse.

Inhalations do not play an important part in the treatment of catarrhal pneumonia. Von Ziemssen advises the inhaling of equal parts of chloroform vapor and atmospheric air, stopping short of com-

[1] Sturges and Coupland, *Pneumonia*, p. 253.

plete narcosis, in cases in which considerable portions of lung-tissue are rendered useless by inflammation or œdema. Under its use respiration becomes deeper, its frequency is diminished, and cyanosis disappears. The inhaling of turpentine vapor is suggested by Bartholow. Oxygen, however, is the gas most frequently employed with advantage in such cases, since the interference with normal respiration indicates its employment.

DISEASES OF THE PLEURA.

By RUDOLPH MATAS, M. D.

INFLAMMATORY DISEASES OF THE PLEURA.

Pleuritis.

GENERAL CONSIDERATIONS.

The word "pleuritis" or "pleurisy" is a generic term which signifies an inflammation of the pleura, and as such is susceptible of subdivision into species according to the exciting causes, the particular areas involved, and the various results which follow. From the etiological standpoint we thus classify pleurisy into two fundamental divisions: 1st, Primary (the so-called *pleuritis a frigore*); 2d, Secondary: *a*, pleurisies by propagation or extension—viz. traumatic, or from pulmonary (meta-pneumonic pleurisies) or pericardial lesions, etc.; *b*, the infectious pleurisies, in which the serous inflammation is but a local expression, a secondary manifestation, of a general constitutional condition—viz. the tubercular, rheumatic, exanthematic, uræmic, typhoidal, syphilitic, and septic pleurisies. The topographical conditions also suggest other distinct varieties—*e. g.* the partial and complete pleurisy, the diaphragmatic, interlobar, and mediastinal pleurisies. The pathological sequences of pleural inflammation also vary, and in consequence we have the typical plastic or "dry," the sero-fibrinous, the purulent, and hæmorrhagic pleurisies.

Of great therapeutic importance is the clinical division of pleurisies according to the intensity or course of the inflammatory process—viz. hyperacute (*pleuritis acutissima* Fräntzel), acute, subacute, chronic, and latent. While these divisions cannot be classed as varieties of pleurisy, since they may constitute a mere phase of any of the preceding true varieties, they are nevertheless all important in deciding the therapeutic attitude of the practitioner.

While the aim of modern research has been directed mainly toward the discovery of the specific pathogenic agents in the production of pleural inflammation, especially since the results of recent bacteriological investigations have proved so fruitful in defining the pathogenesis as well as indicating the therapeusis of the purulent types of this affection, it must still be admitted that the division of pleural inflammations

by their etiology is at present of greater theoretical interest than practical value to the clinician.[1] To the practitioner the degree of intensity of the initial phenomena, and the character of the exuded products resulting from this inflammation, and the condition of the compressed lung, together with a knowledge of the complicating conditions, must still remain the elements which profoundly affect his line of treatment, no matter what the presumed or known pathogenic factor may be.

Of prime importance in the treatment of this condition is the appreciation of the general fact that pleurisy is simply an inflammation of a serous membrane, and that as such it must react to irritants in a manner peculiar and common to all serous membranes. This reaction, which is illustrated as well in the phlegmasiæ of the other serosæ—the peritoneum, pericardium, arachnoid, tunica vaginalis, etc.—resolves itself essentially into an invariable tendency to hyperæmia, followed by exudation and proliferation, which may end in either adhesion of opposed surfaces or in a sero-fibrinous, sero-purulent, or hæmorrhagic transudation. These being the general characteristics of serous inflammation, the treatment of pleurisy must be based on the general therapeutics of serous inflammation *plus* those special modifications called for by the anatomical and physiological relations of this particular serosa.

[1] In a recent and most representative discussion on the etiology and treatment of acute pleurisy at the Third Congress of Italian Physicians, held in Rome Oct. 20–23, 1890, Professor Patella of Perrugia, who led the debate, summarized the present status of the question: "At present we know that there are pleurisies of infectious microbial origin. But (primary idiopathic) sero-fibrinous pleurisy is still regarded as due to a rheumatic causation, and yet we cannot well explain its pathogenesis without appealing to some other agency than "catching cold." It is probable that cold only prepares the soil for microbic infection by modifying in some manner the circulation in the lymphatics and other vessels. But how do the pathogenic germs find their way into the pleura? This is a question which, I must admit, is difficult to answer. Nevertheless, Fränkel has demonstrated that the germ of purulent pleurisy (the encapsulated micrococcus pneumoniæ) is found in the tonsils, whence by following a lymphatic route it may easily find its way to the pleuræ. We might therefore admit the practicability of the same route as an avenue of infection in simple sero-fibrinous pleurisy. . . . . Finally, I believe that, as far as the etiology of primary pleurisies is concerned, we may at the present time establish the following conclusions:

"1st. There are sero-fibrinous pleurisies which are due to the encapsulated micrococcus of Fränkel.

"2d. There are others, in which the effusion is very abundant, which are of exclusively tubercular origin.

"3d. In many tubercular individuals pleurisy may assume a simple non-tubercular type.

"4th. There are pleurisies of chemical origin which are still obscure and insufficiently studied.

"5th. It is more in the province of clinical medicine than in the power of bacteriological research to determine the nature and causes of primitive pleurisies.

"6th. As to the pleurisies which are developed secondarily to an acute pulmonary affection—meta-pneumonic pleurisies, for instance—their etiology is evidently that of the pneumonia, and their prognosis is in a general way more favorable than that of the primary pleurisies." (*La Semaine Médicale*, Oct. 29, 1890.)

While this consideration is paramount in the treatment of pleurisy, we should not under-estimate the great importance of a proper recognition of the underlying constitutional condition, whether pathogenic or associated, as a proper appreciation of this must necessarily modify the therapeutic efforts made toward effecting a control of the local condition.

In a contribution of this character, in which the study of the disease is entirely subordinated to its therapeutic application, it is impossible to dwell upon the details of the etiology, pathology, and symptomatology of each one of the varieties of pleurisy: it is essential, however, that we should know the natural history of the morbid process in general, the nature or character of the abnormal products created by this process, and which it is the object of our therapeutic effort to prevent or remove, and the means by which Nature, unaided, attempts to effect their removal, so that by a better knowledge of these facts we may aid her in the most rational and physiological manner.

Let us rapidly survey the anatomical and physiological conditions. Since the important and historic researches of Recklinghausen, Axel-Key, Retzius, Klein, and others it has become an established fact that the pleuræ, like the other serosæ, are nothing less than large lymph-spaces communicating directly through large orifices (stomata) with a vast subpleural lymphatic plexus. This plexus is intimately interwoven with the arterio-venous capillary plexus, and is unequally distributed under the parietal pleura. The lymphatics in the costal pleura are arranged in two layers: a superficial plexus, which is separated from the pleural cavity by the mere thinness of the epithelial layer, and is arranged into a canalicular system similar to that described by Auerbach in the muscular tissues of the intestines; the deeper lymphatic set is separated from the preceding by the subpleural connective tissue proper, and is more intimately related to the intercostal muscles. According to Dybkowsky, the lymphatic plexuses are only found in the intercostal spaces; they are absent on the surfaces of the ribs. From this anatomical arrangement it is plain that the respiratory movements of the thorax and of the lung must have a remarkable influence upon the absorbent functions of these vessels—a conclusion that has been clearly demonstrated by Dybkowsky's classical experiments. During respiration the intercostal spaces become narrower; the soft parts that occupy them are relaxed and projected into ridges in the direction of the pleural cavity. Under these circumstances the lymphatic spaces are obliterated and absorption is nil. During inspiration the expansion of the chest causes a widening of the intercostal spaces; the walls of the lymphatics separate, the stomata gape open, and absorption is invited.

When the pleural cavity is injected with fluids holding particulate

elements in suspension, the particles are only absorbed by the costal pleura; these particles (coloring matter) have never been found in the pulmonary or mediastinal pleura. The rapidity of absorption is in direct ratio with the frequency of the respiratory movements; as, for instance, after section of the pneumogastric, which causes the greatest inspiratory efforts on the part of the animals experimented upon. It is probable that the absorption of liquids is effected throughout the whole pleural surface, but the more solid contents are most probably absorbed by the costal pleura in the intercostal space, where the stomata, or gaping lymphatic mouths, are most numerous. The absorbent powers of the normal pleura are very energetic: if a saccharine solution is injected into the pleura, it will rapidly disappear, and the sugar can be almost immediately detected in the urine.[1] Like all serous membranes, the pleura consists of a single endothelial cellular layer (of the irregularly-shaped polygonal type) resting upon a basement membrane.

With Germain Sée, we will repeat that whatever may be the pathogenesis of a given pleurisy, the pathology of the process always reduces itself to three histological conditions: viz. congestion, exudation, and proliferation. The difference in the degree of intensity in either the whole or each one of these conditions constitutes the basis for the differentiation of the clinical types of this disease. By taking the commonest and most classical type of acute pleurisy, the sero-fibrinous variety, as an illustration, we will find it easier to study the evolution of the pleuritic process and demonstrate more effectively the essential difference between this and other types.

The initial fluxion and congestion is the primordial fact in pleuritic inflammation. It may be characterized by simple discoloration or the most intense ecchymotic injection of the pleura. The blood-vessels are dilated and gorged with blood, the lymphatics and lymph-spaces distended with leucocytes, and the connective-tissue interspaces are swollen with a flood of plasma. The epithelial surface cells swell, rapidly proliferate, become stratified with superimposed layers of embryonal cells, which are continuously shed and dropped into the more dependent portions of the pleural sac when they mix with the serum that is constantly transuding from the swollen pleura. The fibrinogen of the effused serum is now acted upon by the fibrino-plastic matter of the leucocytes of the pleura and of the embryonal tissue, so that fibrin is rapidly formed. The coagulation of the fibrin thus formed upon the inflamed surface gives rise to the rough "bread-and-butter" appearance which is so readily recognizable by the naked eye in the earliest days, even hours, of the inflammation. The fibrin thus exuded constitutes the *pseudo*-membrane of pleurisy; but the

[1] M. Sée, *Dict. Dechambre*, 1888.

morbid activity of the inflamed pleura does not end here, for in the course of a few days a true new granulation-membrane is developed directly from the pleura as a histological part of the serosa, and not a mere exudation which is foreign to it, as in the case of the fibrinous pseudo-membrane of the acute stage. The difference between these two formations is a capital one from both the pathological as well as therapeutic standpoint, and should be well appreciated; for the first is a temporary formation, the removal of which may be hastened by remedial measures, while the other is a permanent condition that practically defies all treatment.[1]

As fast as these granulations develop, the primitive pseudo-membranous and avascular fibrinous layer which overlies them undergoes a rapid fatty degeneration, the fibrils of the degenerate exudate being absorbed by the lymphatics. Finally, the embryonal cells of the granulation-tissue assume a more adult type, so that when the serum interposed between the opposed visceral and parietal surfaces is absorbed, and the opposing granulations are allowed to come in contact, adhesions take place which permanently bind the opposed surfaces by firm bands of fully-formed connective tissue. On the other hand, when the absorption of the effused fluid is too long delayed and apposition is prevented, then the granulation-tissue cells mature, and end by forming a true endothelial surface of adult pavement cells, simulating the original pleural surface, and giving to the new membrane that peculiar lustre or polish that characterizes the cystic interior of the very chronic cases. It is easily understood that in such cases the prospect of securing obliteration of the pleural cavity by adhesion, even after the permanent removal of the contained fluid, is hopeless, since the apposed smooth surfaces will no more unite than will the original surfaces of the healthy pleura. The *rationale* of the excision or extirpation of this thickened pleura after resection of the costal walls, as successfully practised by Schede of Hamburg, Kuester of Berlin, and others, is well understood, and its justification, as the only radical means of relief, appreciated.

We have already described the method by which the fibrin exudation of acute pleurisy is formed, and we have incidentally explained that in consequence of the great afflux of blood to the pleura a large amount of liquid plasma is exuded. The laws that determine the

[1] The older authors believed that this new vascular membrane was produced by the *organization* of the exuded fibrin, whereas it is now well understood, since the investigations of Virchow, Robin, Charcot, Vulpian, and others, that the formation of the new granulation-membrane is coincident with the disorganization and disintegration of the primitive pseudo-membranous exudate. The new membrane is formed by the proliferation of the endothelial cells associated with a rapid process of vascularization originating in the pleural capillaries proper, and causing the formation of a typical granulation-tissue.

amount of this fluid exudate have not been fully discovered. It is certain that the intensity of the initial congestion does not determine the quantity, because it is notorious that some of the most painless and insidious pleurisies—*e. g.* latent pleurisies—are the ones that are frequently associated with the largest amount of fluid; while, on the other hand, usually the most acute (primitive) pleurisies are frequently arrested at the incipiency of the plastic stage, and are followed by early adhesion of the apposed pleural surfaces. At any rate, the existence of this serous exudate is one of the capital facts in the history of pleurisy; and it is its presence which occasions the most dangerous complications and calls for the most energetic treatment.[1]

We have already noticed the evolution and involution of the more solid products of pleural exudation. We must now simply mention that when recovery takes place the effused fluid is either rapidly or gradually absorbed, the floating flocculi of fibrinous exudation disappear by absorption and approximation of the apposed pleural surfaces takes place. The fibrinous pseudo-membrane, if it exists, may cause a temporary agglutination of the pleural surfaces, but this is not permanent until the vascular granulations of the true new tissue which underlies it have coalesced, and a network of adhesions is formed by a newly-developed connective tissue of the adult type.

We have also stated that the character of the exudate distinguishes the nature of the pleurisy. We can now add that the sero-fibrinous pleurisy is distinguished by a predominance in the amount of liquid exudate; the acute plastic pleurisy by the preponderance of fibrinous *pseudo*-membranous exudate and scantiness of fluid; the true dry

[1] This liquid is nothing else than diluted blood-plasma. The proportions of its constituent elements vary with the acuteness of the inflammation that causes it. The albumin and fibrin which it contains are in greatest excess when the inflammation is most intense. In old or chronic effusions, in which the inflammatory process is of a low or sub-acute grade, the fluid is very poor in coagulable matter. The same may be said of the morphological elements which are found in it. The more recent and acute the process, the more abundant will they be. It has been claimed, and with some good evidence, that the wealth of the fluid in solid constituents furnishes indications of prognostic value. Laboulbène believes that the cure of a pleurisy is more likely to be rapid if the quantity of fibrin is great. Mehu and Constantin Paul have proved almost conclusively that the poorer the effusion is in solid matter the more promptly will it reproduce itself (Vidal). Repeated observation has convinced the author of the correctness of this assertion, and while he admits with Fräntzel and others that this is not always true, he still believes the truth of the general conclusions.

In connection with the microscopic characteristics, it should be remembered that even the most limpid serum removed from the pleural cavity reveals the abundant presence of blood-corpuscles. Dieulafoy teaches that any specimen that contains no more than 3000 red corpuscles to the cubic millimetre has no tendency to suppuration, while if it contains more than this it is almost certain to become purulent. When discussing the treatment of empyema we will dwell upon the later revelations of mycological investigations, and will refer to the more positive and reliable indications furnished by bacteriological tests.

pleurisy,—*pleurésie proliférative* (Lancereaux), *chronic hyperplastic pleurisy* (Vidal), interstitial pleurisy (Loomis),—is distinguished by almost the total limitation of the process to the formation of a new granulation tissue, ending invariably in true connective-tissue adhesions. In the more aggravated and typical cases the connective-tissue proliferation is of a progressive character, involving the whole pleura and causing a total obliteration of the cavity, encapsulating the lung in a sclerogenic mass which may lead to chronic fibroid changes in the lung itself, and thus produce the permanent atrophic alterations which characterize pulmonary cirrhosis of pleuritic origin,—the chronic pleurogenous pneumonia (*pneumonie chronique pleurogène*) of Brouardel and Charcot. Under these circumstances it will be readily understood that in this rarer form of pleuritic disease the new connective-tissue formations which are started in the pleura constitute simply the beginning or initial stage of a morbid process—a process which ends in the lung itself, and is not the *finale* of a pleurisy.

From this synoptical review of the more essential inflammatory pleuritic changes it is plain that the spontaneous cure of this inflammation may be accomplished by the unaided efforts of Nature—a fact that has been sufficiently proven since the days of Skoda and the Viennese school of therapeutic nihilists. The natural cure of the disease, which is mainly effected by the spontaneous absorption of the exuded products and the final adhesion of the apposed serous surfaces, is in reality an intrinsic characteristic of all the *acute* non-purulent pleurisies.[1]

It is only in the chronic cases, in which the absorbent functions are interfered with by an insuperable barrier of connective-tissue neoformation, or in which the presence of a complicating agency (tubercle) which perpetually maintains the effusion, that the natural process fails, and a cure can only be effected by therapeutic intervention. In the purulent pleurisies the resources of Nature are powerless to correct the morbid process, the natural means of securing the removal of the purulent product leaving always imperfect results, which are inferior to the opportune intervention of the therapeutist.

The natural tendency to recovery must necessarily depend upon the underlying pathogenic and anatomical conditions. In general terms, this *tendency* may be stated to be *greatest* in *a*, the most acute type, the acute plastic pleurisy (characterized by large fibrinous exudation and scant serous effusion); *b*, *less* in the subacute or sero-fibrinous pleurisy (with predominance of serous effusion); *c*, *still less* in chronic serous pleurisy with hyperplastic walls; *d*, *none* in the purely hyperplastic or interstitial progressive variety; *e*, *worse* in the purulent varieties.

[1] Out of 200 cases of pleurisy reported by A. L. Mason 132 recovered without having to resort to thoracentesis, *Bost. City Hosp. Reports*, 3d Series, 1882.

In prognosis this intrinsic tendency to recovery may be, therefore, graphically expressed as follows: acute pleurisy, very good; subacute pleurisy, good; chronic pleurisy, fair; hyperplastic pleurisy, bad; purulent pleurisy, very bad.

The frequent occurrence of spontaneous recovery led at one time to a methodical expectancy, a quasi-complete therapeutic nihilism, which, while very instructive in the way of studying "the natural course of disease undisturbed by therapeutics" (Skoda), was conducive to the most disastrous practical results. In healthy contrast with this perilous tendency we quote the language of Fräntzel,[1] who, writing in 1875, impressively says: "There are many physicians, even now-a-days, who adhere to the expectant method which came in vogue now more than thirty years ago, and who recommend that pleuritis should not be submitted to medical treatment unless special symptoms are present which threaten life. They assert that inflammation of serous membranes—pleuritis, pericarditis—unless attended by very great effusion, are not dangerous diseases and will get well of themselves. What infinite mischief has the adoption of this view already inflicted on such patients! It is only necessary to have once seen with observant eyes how such patients inevitably and with the direst sufferings are condemned to certain death to induce us to strive with all our might in every fresh case of pleuritis or pericarditis to quickly reduce the inflammation and bring about as complete an absorption as possible of the deposited exudation."

When we consider the disastrous consequences of exudation in binding down and permanently crippling the expansive power of the lungs, and thus permanently subtracting a large respiratory area from the patient; when we consider the risks incurred by those who carry with them the large unabsorbable accumulations of chronic pleurisy; when we look on the permanent skeletal deformities induced by those who recover from these effusions,—it is realized that neither the expectant nor the purely symptomatic treatment can be the ideal of the practitioner, whose aim should always be directed toward a *restitutio in integrum*, and not a cure *ad partem*, as we are still unfortunately so frequently compelled to admit is the result of our best and most approved therapeutic efforts.

The question which, therefore, presents itself for consideration at the very threshold of this subject is, Can acute pleurisy be aborted? Is it possible to jugulate the inflammatory process at the very start, so as to modify and weaken it sufficiently to abbreviate its duration and prevent the formation of the formidable and mischievous exudations that result from it?

This is an old question, and one that has been exhaustively dis-

[1] *Ziemssen's Cyclopædia.*

cussed by all systematic writers, both ancient and modern, and in the most contradictory manner. The older authors—we mean those who flourished after Pinel and Laennec, who first differentiated pleurisy from pneumonia and established its independent position in nosology—gave very serious thought to the subject, and according to their observations, particularly those of Andral, Bouillaud, Louis, and Chomel in France; Cullen, Pearson, B. Bell, Cooper, Abernethy, Alison, Marshall Hall, Watson, and Walshe in England—whose powers of observation are unimpeachable—such an achievement was possible. The antiphlogistic treatment, free and repeated venesection *ad deliquium animi*, and wet cupping were the means by which this result was obtained. There was no question then as to the benefit of bleeding, only the quantity of blood to be abstracted was the subject of controversy. Over fifty years have now elapsed since that time, and, while there are yet at present men who stoutly uphold the correctness of the old practice—M. Peter in France, for instance (1880), and Meyer and Fräntzel in Germany (1882)—things have so changed that it has now become an anachronistic absurdity to discuss the efficacy of venesection unless it be to denounce it.

Without attempting to enter into the merits of the question, we cannot help wondering at the extreme oscillations of the pendulum of professional opinion, and asking ourselves why the modern generation has set itself down so firmly against the use of the lancet when our ancestors gloried so enthusiastically over its merits. It is remarkable to read that so competent and careful an observer as Louis, who cupped and bled his pleuritic patients, maintained in the discussions of the French Academy that "Pleurisy rarely, if ever, caused death." Professor Peter, who has lived to practice most actively both the older and modern methods of treatment, says that "if the old method of treatment was followed more often now-a-days, there would be less frequent appeals to the aspirator and to the knife, and that pleurisy would claim a much smaller mortality."[1]

Those who are especially interested in the question raised by Professor Peter would do well to consult the refutation given by Dujardin-Beaumetz in his admirable *Leçons de clinique thérapeutique.*

In direct contradiction to the recent claim of Peter we may listen to the opinion of the elder Flint, whose calm and unbiassed judgment, based upon an enormous professional experience in this country of over fifty years, deserves the great consideration that has always been accorded to the utterances of this foremost of American clinicians. In speaking of the influence of bloodletting in the treatment of pleurisy, he says: "Experience and pathological reasoning combine to show that bloodletting does not exert a *direct* controlling effect upon an

[1] *Leçons de Clinique médicale,* 3d ed., 1880.

inflammatory disease. It may exert a powerful immediate effect as a palliative measure, but whatever curative power it may possess is exerted *indirectly*. Its therapeutic action, in general, consists in lessening the force and frequency of the heart's action, in other words, in diminishing the intensity of the symptomatic fever. In the early period of an acute inflammation accompanied by high febrile movements, as indicated by a pulse accelerated and of abnormal strength, the abstraction of blood affords relief and may contribute to a favorable progress of the disease. It should enter into the treatment of a certain proportion of cases, *provided other and more conservative means for the same ends are not available.*"

"The evils of bloodletting arise from the spoliative effect upon the blood. It diminishes the red globules, and these during the progress of the disease are not readily reproduced. It induces thus the anæmic condition, and in this way impairs the vital powers, etc. . . . . The useful effects of bloodletting may frequently, if not generally, be obtained by other means, which require less circumspection in their employment, because if injudiciously resorted to they are in a less degree hurtful, etc." [1]

It is unnecessary to state that the views of this distinguished observer, whose authority has stamped with its influence the practice of many generations of American physicians, are those of almost all representative clinicians the world over.

For our part, we can conscientiously state that throughout a large hospital and private experience during the last twelve years we have never seen a case of acute pleurisy in which we felt that the abstraction of blood by venesection was necessary or justifiable. This was not due to prejudice, but simply because of the inherent weakness of the patients, which radically unfitted them for venesection—a peculiarity common to all large metropolitan populations, which Peter himself admits interferes with bloodletting in Paris itself. It should be added that throughout our private experience we have acted independently and without bias against bloodletting; in fact, we have never failed to resort to the lancet in any condition in which vascular depletion appeared to be the best means of affording relief—*e. g.* failure of the circulation from over-distension of the right heart, etc. This is partly due, however, to the fact that the majority of hospital cases have applied for relief after the acute stage had passed, and the existence of the second exudative stage precluded the consideration of all depletive measures. Neither can we state that in private practice has venesection ever appeared necessary, since in all the cases the prompt application of other remedial measures has given the most satisfactory relief from all the symptomatic phenomena.

[1] *Principles and Practice of Medicine*, 4th ed., 1873.

In summing up the status of modern opinion in regard to bloodletting in pleurisy we may state that, while the immediate benefits of bloodletting are not denied, they are nevertheless not accorded the enormous importance of former years, the effects of venesection being only indirectly beneficial and not specifically curative. Since bloodletting affords only symptomatic relief, and does not prevent the further evolution of the pleuritic process into its more mature and dangerous stages,[1] it cannot be regarded as a jugulating agent in the highest sense, and must consequently be supplanted by other therapeutic agents that afford the same symptomatic relief with decidedly less damaging effect upon the patient's resources. We may add, also, that the great therapeutic discoveries that have been made in the last few years have, much more than the influence of doctrinal objections, greatly justified the modern aversion to bloodletting. It is very natural that with the scarcity of positive potent therapeutic agents which characterized the practice of the middle and earlier periods of this century, the immediate brilliant effects of venesection should have assumed magnified proportions, but it is equally plain to understand why with a better appreciation of the etiology and natural history of disease, and a better understanding of the effects of drugs (especially the positively brilliant additions that have been made to the materia medica in the last ten years), that the effects of bloodletting should have been completely overshadowed and forgotten.

Finally, while we cannot claim for modern therapeutics the absolute power of jugulating the pleuritic process in all cases, we can emphatically state that we are able greatly to diminish the severity or violence of the initial stages, and probably control its career in a way more prompt, more conservative, and more efficient than by the depleting practices of the antiphlogistic system.

TREATMENT OF THE FIRST STAGE: HYPERÆMIA AND PLASTIC EXUDATION.

Apart from the possibility of aborting or jugulating the inflammatory process at the very onset of the invasion, there are several indications (*indicationes morbi*) which demand the attentive consideration of the therapeutist.

The first of these is the physiological indication of rest. In pleurisy general (or bodily) and local rest are demanded by the inflamed serosa.

Rest.—Long ago, Mr. Hilton, in his admirable lecture on *Rest and Pain*, pointed out the resemblance between the pleura and pericardium and joints. Much longer before him Bichat had already established

[1] Some authors as competent and careful as Loomis contend and teach that bloodletting really favors the greater transudation of serum in the second stage.

the anatomical and physiological unity of all the serous membranes. The pleural cavity represents a huge joint constantly in motion. It has two surfaces covered by serous membrane, gliding smoothly upon each other by the aid of lubricating fluid. Mr. Hilton applied his law of associated muscular action, nerve-supply, and function to the pleura, showing how, when inflammation takes place, the nerves of the pleura that are directly in communication with those supplying the intercostal muscles call for cessation of movement, and that the pain felt in the skin over the inflamed area is the agent by which the needed rest is obtained. "Practically, the same thing occurs in the joint that is inflamed and painful from acute rheumatism. Probably the resemblance between this inflammation of a serous membrane and that of a joint could be more striking were the conditions exactly similar. But in the case of the pleural serous membrane complete rest cannot be obtained. The lungs cannot cease breathing and the heart cannot stop beating." Probably, as suggested by Hilton and Powell, this accounts for the more fibrinous and adhesive character of the effusion, a further effort of Nature to secure rest. In the case of the joint immediate rest is secured, and the effusion is not adhesive in ordinary cases.

It is doubtless due to the influence of Hilton's teachings that the attempt at securing rest by fixing the affected side, and thereby diminishing the respiratory movements, is so frequently applied at the bedside. This practice, which is so largely followed in English and American hospitals, is a good one in the acute stage. There is no doubt that much comfort is given to the patients by it. The method (Robert's) simply consists in applying strips of adhesive plaster two to three inches in breadth, extending from the spine posteriorly to the sternum anteriorly, around the affected side. This was the method almost invariably practised by the late Professor Samuel M. Bemiss of New Orleans, who always expressed himself as highly pleased with it throughout his large and eminently successful practice.

Following the same idea, Richard Otto of Dorpat[1] recommends that an ordinary cotton bandage, two and a half to four inches in width, be applied tightly to the thorax. This compression he believes is useful whether the inflammation has just begun or whether it has passed to the second stage. In either case, if the bandage is tightly applied, it will give great relief. At first it is rather uncomfortable, but if removed at the solicitation of the patient he will soon beg to have it reapplied.

In addition to these local mechanical restraints, it is necessary, no matter how mild the case, to place the patient in bed. The patient should be allowed to place himself in the position in bed which he

[1] *Berlin klin. Woch.*, Sept. 30, 1889; *Annual of the Universal Medical Sciences*, 1890.

finds most comfortable. He should be forbidden to talk, and should be prevented from making any unnecessary movements, and a nutritious but plain diet, without stimulants, should be given him.

In the way of hygienic indications the sick-room should be well ventilated and kept at a temperature of about 65° F. (Loomis).

As a preliminary to further treatment a saline purgative is usually prescribed. A pint of the effervescent solution of the iced citrate of magnesium, taken in broken doses, a double dose of Seidlitz powders, a dose of compound cathartic pills, a draught of the purgative mineral waters (Hunyadi Janos, Friedrichshall), an ounce of Epsom salts, or 1 drachm (ʒj) of the pulvis hydrargyri chlor. mite et jalapæ (*National Formulary*), constitute a repertory from which a selection may be made that will suit the requirements of any particular case. As a general rule more powerful purgatives should be reserved for the more robust and plethoric patients. The evacuations resulting from these purgatives should be passed in a bed-pan, so as to cause the least disturbance of the patient.

In addition to the preceding indications, the call to diminish the intensity of the pleural engorgement is one of primary importance at this stage of the disease. To meet this indication was the object of the older antiphlogistic method with its large bleedings and violent emeto-cathartics and counter-irritants. While modern practice has totally discarded venesection, it has not been able to dispense altogether with the principle of local depletion, counter-irritation, and derivative medication, and still tolerates it, though in such an attenuated form that the practice would be repudiated as such by the disciples of Rasori and the exaggerated school of contra-stimulation. At present local depletion, the blister and the lesser counter-irritants, the purgatives, diuretics, and diaphoretics, are the only relics that have survived the general downfall of antiphlogism.

While we have never had occasion to realize the necessity for venesection, especially that large and repeated bloodletting *ad deliquium animi* which was formerly regarded as essential for the control of the disease, we do believe that the local abstraction of blood—say 4 to 6 ounces—by means of the wet cup is an excellent means of obtaining an amelioration of the local symptoms and general distress, the relief being out of proportion to the amount of blood abstracted. By means of the cupping-glasses with air-tight stopcocks, that may be attached to the ordinary Dieulafoy or Potain aspirator or the Allen surgical pump, a vacuum can be promptly obtained, so that, after preliminary scarification with the special instrument for the purpose, the desired local depletion can be very effectively obtained without much annoyance to the patient.

This wet cupping, if resorted to at all, should be applied at the very

earliest moment of the initial stage: it is almost exclusively indicated in the acute pleurisies with very inflammatory, painful, and feverish symptoms of robust and plethoric subjects. In all other pleurisies, with subacute symptoms occurring in debilitated subjects, it is positively contraindicated. For this reason cupping will always remain a more popular and effective indication in healthier rural districts than in metropolitan practice.

It is in the class of the subacute pleurisies in weaker patients that another relic of the antiphlogistic system—the blister—will always continue to find application.

While the blister has never had more powerful enemies than in the present decade, its triumphant survival in the treatment of inflammatory affections of serous membranes, and in this one specially, is one of the best proofs of its utility. As a rule, the majority of systematic writers deprecate the application of blisters in the acute or initial stage of pleurisy, even when they advise it in the later stages. Nevertheless, it is apparent to anyone who considers the pathological anatomy of pleurisy that blisters or any other counter-irritant is much more likely to accomplish its purpose in the early stages of the disease, when the membrane has not been seriously altered, than in the later stages, when a thick coat of exudation has been spread over its internal surface. It is in the later stages, when absorbent orifices of the lymphatics are entirely plugged by exudation, that we fail to see the rationale of the counter-irritant. We believe with Professor Peter that if blisters are at all useful in pleurisy it is in the first stage, and rarely in the later stages.

In Louisiana, where the older traditions of the French school still linger among the Creole population, the blister, if not constantly applied, is almost always expected in all pleuro-pulmonic phlegmasiæ, and, while there is frequent abuse of this agent, the beneficial results that are constantly observed from its application leave no doubt in the mind of the unprejudiced observer of its possible utility. The blister, if applied, should never remain longer in contact with the skin than the time necessary to produce vesication. The epidermis should not be removed, but should be simply punctured to allow the retained serum to escape. To make a blister suppurate by the application of irritating ointments, etc., is absolutely unnecessary under any circumstances. It should be remembered that the blister is to be used most cautiously in children on account of the strangury and other evidences of cantharidism that it is more likely to produce. It is of course absolutely contraindicated in all albuminuric subjects or those affected with genito-urinary diseases, for a like reason.

In ordering the blister the emplastrum cantharidis (*U. S. Pharm.*), freshly prepared, should be preferred to the numerous ready-made

vesicating plasters that are found in the shops. The size should be regulated by the area and intensity of the pain. Cantharidal collodion (collodium cum cantharide, *U. S. Pharm.*) may be also applied with a camel's-hair pencil in lieu of the blister, but the unreliability of this article is notorious, and the plaster is to be preferred whenever a prompt and energetic action is desired.[1]

In the milder cases, in which the pain is not very intense nor the fever high, dry cupping, by means of the aspirating pump already mentioned, and followed by turpentine stupes prepared with flannel cloths large enough to cover the affected side, wrung out of hot water and sprinkled with spirits of turpentine, is excellent local treatment. Mustard, whether in sinapism or in the shape of the leaves sold by the manufacturer, is a most elegant but less effective and more painful counter-irritant. When alternated with applications of tincture of iodine it is useful in the treatment of the "dry" pleuritic stitches of phthisis.

In children counter-irritants cannot be applied as in adults. They cause great pain, restlessness, and even delirium, and for this reason gentler means of drawing the blood to the surface must be resorted

[1] In ordering a blister the precaution should not be omitted to make frequent examinations of the underlying skin in order to withdraw the plaster when vesication has taken place. This effect is usually observed in three hours, though in many cases, especially when applied to older and less sensitive skins, it may not be observed for several hours longer. When the vesication is produced, the plaster must be removed and a warm, very mushy, and hot flaxseed or slippery-elm poultice must be applied. The poultice has a very soothing effect upon the blistered surface, especially if the proximal surface of the poultice is smeared with hot green oil (ol. hyoscyam. infus.), or preferably the *Baume tranquille* of the French Codex, which is so largely used by the Creoles in Louisiana. The poultice may be renewed every three hours during the first day, when the large serous accumulation under the blistered surface is to be drained away by puncture of the blister without removing the pellicle. After this the poultices are discontinued, and replaced by a dressing of antiseptic oil, preferably applied by keeping cloths saturated with a mixture consisting of

℞. Campho-phenique, ℥ij;
Liq. vaselini, q. s. ad ℥vj.—M.

This application has the advantage that it will require less frequent renewal than the ordinary salves and oils that are generally used in the household. In this connection a very convenient and useful dressing not generally known in this country, which was introduced a few years ago by M. Lelievre, a French chemist, and known as the instantaneous Iceland-moss poultice (imported by E. Fougera & Co. of New York), is worthy of notice. In treating travellers, single persons, etc. this application offers especial advantage. It consists of a substance extracted from the *Fucus crispus*, which is preserved in sheets like paper. For use a piece of suitable size is cut and dipped in warm water; it swells rapidly, softens, and can be immediately employed as a poultice. It can be soaked in the liquid antiseptic vaseline already mentioned, and can be allowed to remain indefinitely upon the blistered surface, as it does not decompose. If hot water alone is used, the heat will be retained by the gutta-percha tissue or thin oiled silk sheet which always accompanies these poultices as prepared by the manufacturer. In very sensitive persons oleate of cocaine (4 per cent.) and morphine may be added to the vaseline with which the poultice is saturated.

to. Nothing is better in this class of cases than a flaxseed poultice, which, acting as a cutaneous derivator, also soothes the engorged pleura by the direct effect of heat. Even in adults, hot flaxseed or slippery-elm poultices, if not too heavy, applied as a partial jacket to the whole side, give great relief.

The chest-dressings of Von Gieth and Hunt, which have been recently introduced, are worthy of mention as substitutes for poultices in the very painful cases, in which the movements of the patient are interfered with, and in which a permanent dressing, to last for several days, is desirable.

The dressing of Professor Von Gieth of Munich, which has been recently described by Dr. Thornton Parker,[1] is particularly adapted to infantile cases. It is prepared as follows: "Pure olive oil (no other substance will be just as good) is poured in sufficient quantity into a previously warmed bowl, and a strip of old soft cotton cloth, large enough to encircle the chest, is placed in the bowl and completely saturated with the oil. This is then applied to the patient's chest, and outside of it a second strip of dry cloth is placed, and, if necessary, a third, which completes the dressing. This application is said to be most acceptable to patients, and more successful in results than the other applications previously recommended." Over this, Otto's chest bandage, previously described, to diminish the respiratory movements and secure rest, may also be applied.

On the other hand, the dressing recommended by Dr. William Hunt of Philadelphia[2] commends itself for its cleanliness. "If there is to be any cupping or any other preliminary operation, that should be attended to first; then all the ingredients wanted are pure collodion (flexile) and absorbent cotton in smooth layers and a good brush.

"Apply a very thin layer of cotton over the affected side from spinal column to sternum, and secure with collodion smeared thoroughly over it. Then go on with thicker layers, securing them with collodion until a good padding is obtained, paying particular attention to the edges. In double cases the dressing may encircle the chest."

Finally, to conclude with the external applications, which are intended to relieve the pleural inflammation in the first stage, we will simply mention cold applications to the chest. This is unquestionably a very unpopular treatment in the Southern United States, where, as in all warm and tropical countries, cold in pleuro-pulmonary inflammations has always been looked upon with distrust. It is probable that outside of Germany and other colder countries, where, through the influence of Niemeyer's teachings, it obtained a foothold in certain clinics, it is rarely, if ever, applied. The ice-bag, snow poultices, cold compresses, etc., may appeal to *a priori* reasoning, but experience is

[1] *Med. News*, May 9, 1891. [2] *Annals of Gynæcology and Pædiatry*, Feb., 1891.

against them. Even Fräntzel,[1] who is an authorized exponent of German teaching, objects to it, because the cold often brings on violent fits of coughing, and thus an increase of the inflammatory action. Its chilling influence is certainly very disagreeable to most patients, who almost invariably find more comfort in hot applications.

Thus far, the therapeutic recommendations that have been presented for the treatment of the acute stage of pleurisy have been, with the exception of the better appreciation of the value of rest for the inflamed pleura, almost all simply modifications of the older methods of treatment, which were as well understood in the earlier part of the present century as at present.

The present generation, while eliminating the more objectionable features of the antiphlogistic system and accepting its more salutary teachings, has departed essentially from previous ideas in its appreciation of the therapeutics of one agent—opium—and has thereby wrought a most radical and beneficial change upon the treatment not only of pleural, but of all serous, inflammations. In 1873, Austin Flint, Sr.,[2] in dealing with pleurisy, wrote: "A great change has taken place within the last few years with respect to the use of opium in acute inflammations. It was formerly used with much reserve under the apprehension that, acting as a stimulant, its influence upon the local disease must be unfavorable. It was regarded as antagonistic to the antiphlogistic plan of treatment. Clinical experience and sounder pathological views, however, have led to the knowledge of its great value in the treatment of inflammatory affections wherever situated. It is valuable not only as a palliative, but as a curative remedy. . . . . The immediate effect of this remedy is often very strikingly manifest in improvement as regards the local and general symptoms."

The change in opinion with respect to this drug was at first brought about by experience, which was subsequently confirmed by the results of more advanced physiological experimentation. Brunton[3] teaches that opium by its action on the vaso-motor centre in the medulla, and especially by its action on the peripheral terminations of the vaso-motor nerves, which it *contracts*, will prevent or diminish the reflex dilatation of the vessels which the local irritation would otherwise produce. Congestion will thus be diminished and inflammation will be relieved. We thus find in opium an agent which not only acts in a *direct manner* upon the pleuritic process *in loco*, but also by its relief of the symptomatic phenomena—pain, cough, and dyspnœa—through its influence on the sensory apparatus, ensures a degree of local physiological rest to the inflamed organ which is of infinitely greater benefit than that which is obtained by mechanical restraints.

[1] Article in *Ziemssen's Cyclopædia.* [2] *Practice of Medicine.*

[3] *Pharmacology*, etc., 1885.

The late Sir Robert Christison used to say that not only coryza, but probably all inflammations, could be nipped in the bud by opium if it were given sufficiently early and sufficiently freely. This utterance has been strongly confirmed in the treatment of acute pleurisy, the almost unanimous consensus of opinion in this country being entirely in favor of this drug or its more elegant alkaloids.

Loomis[1] says: "The only remedial agent which has seemed to me to have a controlling power over acute pleurisy is opium;" and his opinion is shared by almost all systematic American writers.

The most rapid and effective method of administering opium is by the hypodermic injection of morphine. The injections ($\frac{1}{4}$ gr. each) or the syrup of morphine (1 grain to the ounce) must be administered in sufficient quantities to relieve pain. The effect is the best criterion of its proper administration. This remedy will usually be required during the first week of the disease, during which time the patient should be kept under its influence.

In cases in which the stomach is irritable the hypodermic method is particularly indicated. In the more marked febrile cases its combination with analgesic antithermics—antipyrine, antifebrin (acetanilide), or phenacetin—will be followed by the happiest results.

In the more acute cases a hypodermic injection of morphine should precede all other treatment, the remarkable improvement which follows the initial injection frequently moderating the tendency to counter-irritant and derivative measures which the practitioner would otherwise be tempted to push with unnecessary vigor.

In cases in which the presence of malaria is suspected as a complicating factor, the combination of quinine and morphine is indicated (quinine 20 grains, morphine $\frac{1}{2}$ grain in capsules or wafers); and the effect of this should be maintained by the repetition of smaller doses (quinine 5 grains, morphine $\frac{1}{8}$ grain) every four hours.

The combination which was so much employed formerly (calomel and opium) owes its virtues to the opium. Bartholow says: "If constipation is a feature of the cases, especially if nausea accompanies it, and if there be evidence of congestion in the portal circulation (which is so common in alcoholic and malarial subjects), the most important results may follow the exhibition of a sufficient dose of calomel. The dose should be, as my experience goes, from 3 to 5 grains, and the reasons for its use are that calomel has a distinctly sedative effect on the liver, lessens the physiological activity of its constructive apparatus, lowers the temperature of the blood passing through the hepatic veins into the general circulation, and it depletes by its purgative action the portal system."

This is probably all that remains at present of the old therapy of

[1] *Textbook of Practical Medicine*, 1890.

serous inflammations with mercurials (at least in the acute stage), when calomel was regarded in England and Germany as the sheet-anchor, the *sine qua non*, of the treatment. Mercurials at present only find direct application in the second stage of pleurisy, when their so-called *aplastic* effects may prove of value in preventing or promoting the absorption of the plastic fibrinous (unorganized) exudate.

Among the remedies which are also rapidly becoming obsolete in the treatment of acute pleurisy we would mention the group of vascular and cardiac sedatives, aconite and veratrum viride and tartar emetic. At one time digitalis was classed with this group, but a better appreciation of its physiological effect and a still better appreciation of its uselessness, if not harmfulness, in the acute stage, have withdrawn it from this group and reserved its great powers for other and better circumstances, when, as we shall see later on, it is capable of rendering great service.

While aconite and veratrum viride have been quite serviceable, especially in combating the febrile symptoms of the more pyretic types of pleurisy, and also by diminishing the intensity of the inflammatory process through the general circulatory depression which they cause, their popularity is rapidly on the wane, owing to the vigorous encroachments of the new analgesic antithermics, which are so reliable and positive in their effects and yet so free from the danger of these remedies.

It cannot be doubted that the therapeutics of the acute stage of primary pleurisy has been very greatly strengthened by the introduction of these remarkable derivatives of the aniline-carbon group. Chinolin, kairin, thallin, hydrochinon, pyridin, antipyrine, antifebrin, phenacetin, and salol have all been tried as rapidly as they have been introduced, and, while favorable reports were recorded of the beneficial action of the first five, opinion appears to have definitely settled on the superior value of the last four.

There is not the least question as to the prompt symptomatic relief that may be given to pleuritic patients by the administration of either antipyrine, antifebrin, phenacetin, or salol. By their use the fever is promptly lowered, the pain abates, and the general condition of the patient is very much improved. The profuse diaphoresis that follows the administration of these agents in febrile cases is also of marked derivative benefit, and entirely supersedes the older diaphoretics that were prescribed at this stage of this disease. One of the most valuable features presented by the therapeutic action of this group lies in the fact that their effect is marked in proportion to the intensity of the acute process. The more febrile and acute the invasion, the more rapid the effect. These antipyretics alone (especially antipyrine) are in many, if not the majority, of the cases quite competent to meet the

indications of the first stage entirely. While they cannot supersede opium altogether, their analgesic effect, especially that of antipyrine and phenacetin, will permit us greatly to economize the administration of opium or morphine. In this manner the constipating effects of the opiates are much minimized, while their full benefits are obtained. It is regrettable that exalgin, one of the latest members of this group, should be so toxic and variable in its effects; were it not for this it is possible that the therapeutics of the first stage of pleurisy might be written in the words: *antithermic analgesics*. At any rate, the beneficial effects of this group of remedies on the pleuritic process is so marked that many recent authors have claimed for them a real specific action. If this were the case, however, not only would the symptoms of the disease be subdued, but the local inflammation would also be arrested, and the disease would not proceed to the second stage. This is claimed to be true by several observers, but is not fully confirmed by the writer's experience. The frequency with which acute pleurisy is associated with the rheumatic diathesis has led many observers to the generalization that all idiopathic primary pleurisies—from the so-called *pleuritis a frigore* to latent pleurisy—are but local manifestations of this dyscrasia. This generalization, which is just as erroneous as Landouzy's teaching that all idiopathic primary pleurisies are tubercular, is nevertheless intimately connected with the empiric practice of administering known anti-rheumatics in acute pleurisy. In 1883, Aufrecht drew attention to the decided results he had obtained with the salicylates. In 1885, Müller and Glax,[1] Tetz,[2] and J. Drzewicki of Warsaw[3] confirmed his observations, the last-mentioned writer having tried salol in large doses with still more brilliant results. The marked anti-rheumatic properties of antipyrine, antifebrin, and phenacetin and salol would credit their beneficial action to this theory, the latest and extensive observations of M. Clement of Lyons[4] apparently demonstrating an almost specific virtue in antipyrine. Notwithstanding this, the author believes, as a result of personal experience, that the relief afforded by the antipyretics is mainly symptomatic, though in the true rheumatic cases the relief is as *specifically curative* as it is in acute articular rheumatism. In the other non-rheumatic cases the disease will progress onward to its later stages, though in a modified and less violent form. At all events, it is certain that either one or all—antipyrine, antifebrin, and phenacetin—are far superior to the salicylates, to which they should be invariably preferred.

These agents may be administered in various ways. As the taste

[1] *Greifswald Inaugural Dissert.*, quoted by Vidal, *loc. cit.*

[2] *Therap. Monats.*, No. 7, 1890.

[3] *Med. Rec.*, Aug. 25, 1888; *Annual of the Universal Medical Sciences*, 1889.

[4] *Lyon Médical*, May, 1891.

is not objectionable, their administration in a liquid menstruum is to be preferred: thus:

℞. Antipyrin. et phenacetin., *āā.* gr. xx;
Spiritus vini gallici, ℥ss;
Syrupi acaciæ, ℥ss.—M.
Sig. One tea-spoonful every hour until fever and pain are relieved; then every two, three, or four hours.

The remedy should be suspended if profuse diaphoresis occurs (usually after the third or fourth dose), and is to be repeated when the fever returns. If there is much pain, the addition of morphine may be made as follows:

℞. Antipyrin. et phenacetin., *āā.* ℈j;
Syr. morphinæ sulph., (gr. j–℥j) ℥j.—M.
Sig. One tea-spoonful, after shaking thoroughly, every hour, as with preceding formula.

In case of malarial complication either antipyrine, antifebrin, or phenacetin may be administered in conjunction with sulphate of quinine and morphine in wafers or capsules, thus:

℞. Antipyrin. et phenacetin.,
Quininæ sulph., gr. v;
Morphinæ sulph., gr. ¼.—M.
Dispense in two wafers.
Sig. Take the wafers at half-hour intervals, and repeat the same quantity every two or three hours until pain and fever are controlled.

As a rule, however, it is preferable to administer the antipyretics and morphine in liquid solution or emulsion, and the quinine separately in capsules.

A good combination is that of phenacetin and salol in equal parts (generally in capsular form, 2½ grains of each) after the subsidence of the acute symptoms. Four grains of each of these two agents may be given every two hours to an adult as long as the first stage lasts, when the indications of the stage of effusion will call for a change in the treatment.

In summarizing the treatment of the first stage of acute pleurisy we should state that no special mention has been made of the treatment of the four cardinal symptoms of this stage—viz. *pain, cough, dyspnœa, fever.* But a separate and detailed consideration of the

symptomatic treatments is unnecessary, since the means that meet the *indicationes morbi* will equally relieve the *indicationes symptomaticæ;* thus, the *pain* will be relieved by local depletion, blisters or other counter-irritants, rest, opium, and the analgesic antipyretics; *cough* will be relieved especially by opium; *dyspnœa* will be relieved by the same agents that control pain; *fever* will be specially controlled by the analgesic antipyretics.

TREATMENT OF THE STAGE OF EFFUSION.

As has been already stated, in a certain number of cases the disease stops short at the dry or plastic stage, and the patient is said to have had a "dry pleurisy;" this, however, though common enough in secondary, and especially in tubercular, pleurisies, is rarely observed in cases which have presented in any degree the features of the acute illness characteristic of an attack of primary pleurisy.

In the typical cases the disease, therefore, progresses rapidly to the stage of effusion, this stage being recognized by the signs of liquid accumulation in the pleural cavity. Within a short time—it may be but a few hours from the initial signs of invasion—fluid commences to be effused, and dulness may be detected at the extreme base posteriorly, gradually extending upward toward the apex. With the occurrence of effusion the pain becomes less, the breathing easier and less catching, although quicker than natural. The movements of the affected side are notably lessened, whilst, in marked contrast to the effacement of respiratory sounds on the affected side, is their exaggerated intensity on the sound side. In moderate accumulations the dulness varies slightly with the position of the patient; whilst lying down, for instance, the resonance may be good to just below the nipple, whereas on sitting up there is dulness up to this point, and it may be higher. Over the lower portion of the dull area the respiratory murmur is absent, and the friction is no longer to be detected; but as the upper limits of dulness are approached in the scapular region, distant tubular breathing may be heard, and friction-sounds of a moister character are audible especially in front (Powell).

As the effusion advances the breathing becomes increasingly distressed, until apnœa is threatened.

The signs of pleuritic effusion are conveniently classed by Powell into three groups: (*a*) The cardinal signs of pleuritic effusion, the presence of which is alone essential for diagnosis—viz. (1) percussion dulness; (2) displacement of the heart; (3) annulled vocal fremitus; (4) diminished and altered or absent breath-sounds. These signs are common to both serous and purulent effusions.

(*b*) Subordinate or supplementary signs—viz. (1) increased semi-circumference of chest; (2) intercostal bulging, elasticity, or fluctuation;

(3) Skodaic resonance; (4) altered voice sound; (5) displacement of abdominal viscera; (6) signs in other lung, especially puerile, healthy; (7) cardiac displacement *bruits*. These signs are none of them essential for diagnosis; any and all of them may be wanting.

(*c*) Signs indicative of nature of the fluid—viz. (1) aphonic pectoriloquy (Bacelli's sign); (2) temperature signs; (3) other pyrexial or septic phenomena. These are of special importance with regard to the diagnosis of empyæma, and will be discussed under Suppurative Pleurisy.

Presuming that the reader will find in the synoptical statement just made all that which is essential in guiding him to the differentiation of the therapeutic stages, we will proceed with the therapeutic indications.

"Whilst the inflammatory fever is at its height the less we meddle with any effusion present, unless it becomes of itself a danger, the better. We must bear in mind that a certain amount of effusion is as much to be looked for in acute pleurisy as exudation into the air-vesicles in pneumonia or 'running at the nose' in nasal catarrh, and the products in the three cases do not essentially differ. The pulmonary exudation consolidates *in situ*; the nasal product stiffens the handkerchief; and the exudation into the closed pleural sac remains limpid and liquid only until the exposure to the air or some other means of microbic contamination determines a transformation of the serous to a purulent exudation. Again, given acute inflammation of the coverings of the lungs, a certain amount of effusion is useful in separating and bathing in a bland fluid the tender and inflamed surfaces, and, further, in keeping at rest the affected portions of lung. It is too often forgotten that the lung is in health exercising a constant traction upon the pleural sac, the vessels of which have, therefore, to sustain a negative or aspiratory pressure; this being so, it is but natural and physiological, if these vessels become temporarily weakened and congested by the inflammatory process, that increased exudation should proceed from them. The effect of this transudation is to neutralize lung-traction, and therefore to lessen the afflux of blood to the weakened vessels; it is, moreover, the surest and most natural means of giving that rest to the inflamed surfaces which they need for recovery. The effusion reaches its acme, the flow subsides, and in a few days the tide turns, absorption being effected in a few weeks. Fluid effusion being thus both natural and salutary in acute pleurisy, we must be watchful, but not meddlesome, in our treatment of its earlier stages: up to the end of a week or ten days we need not, in ordinary cases, seriously consider how to promote its removal, and in many, if not the majority of the cases, after this period the fluid will gradually subside by spontaneous absorption" (Powell).

It is generally agreed that the time usually taken for spontaneous absorption of serous exudation in acute pleurisy is from twenty to thirty days. If resolution has not taken place at the end of this time, and if the effusion remains stationary or shows a tendency to increase in spite of adequate treatment, then the case has ceased to be acute, and the disease may be properly assumed to have entered into its chronic phase, and hope for spontaneous absorption must be lessened if not abandoned.

What should be the treatment while there is hope of spontaneous absorption—*i. e.* during the first four weeks following the advent of the second stage?

As a preliminary to the answer to this question it should be stated that our ability to relieve Nature by pharmacological or hygienic means decreases *pari passu* with the length of time that elapses after the fourth week of the effusion. The reason for this is obvious. The longer the effusion remains, the more marked become the pathological alterations in the pleura; structural changes take place, characterized mainly by the consolidation of the plastic matter and the increased formation of true granulation-tissue; the exudation loses its elasticity, the lung becomes more firmly bound down, expansion is increasingly difficult, and with time impossible. Under these conditions the highly absorbent properties of the pleural serosa become rapidly impaired, and finally lost. When this plastic obstruction of the lymphatic stomata has taken place, and a thick barrier of ill-organized exudation is interposed between the vascular and lymphatic absorbents and the contained fluid, what can be expected from derivative, counter-irritant, alterative, or any other sort of deobstruant medication? It is plain, therefore, as Peter has well shown, that if the therapeutist is going to interfere with medicinal agents with the view of aiding the oppressed pleura, he must do it in the earlier or acute stage of the effusion, and not later on when the fluid is encysted in a practically impenetrable capsule of exudate.

Therefore, as soon as the pain of the acute stage has subsided and the friction-sound gives way to the signs of effusion, the administration of opium should be discontinued, and such modifications in the dietary as well as treatment should be prescribed as will better suit the changed pathological conditions. It should be remembered that the indications call for a treatment (1) that will promote serous absorption; (2) that will promote fibrinous, pseudo-membranous, disintegration and absorption; (3) for remedies that will arrest or diminish cellular proliferation (neo-membranous or granulation formation); (4) agents that will promote pulmonary expansion.

As already stated, the patient should not be subjected to any serious annoyance on account of the serous effusion; only in case the quantity

should rapidly increase to alarming proportions. The patient should be given an opportunity to rally after the greater distress and fever of the first week. The digestive and eliminating organs should not be too severely taxed by the purgatives, diuretics, or diaphoretics while they are already severely overworked in attempting the removal of the products of tissue metabolism resulting from the fever and pain.

During this period of rest immediately following the first week of the attack plain but more nutritious diet should be given, the patient should be allowed to sit up, and if the tenderness of the affected thoracic region has ceased, the systematic and forcible compression of the *healthy* side twice a day, during five to fifteen minutes each time, as recommended by Concato of Bologna and Albertozzi of Florence, should be tried. The compression is performed during expiration with both hands applied to the healthy side. The same method is resorted to by Gerhardt in the treatment of pulmonary emphysema, and is very serviceable in promoting absorption. The results of this method are of course more or less favorable according to the youth of the patient and the flexibility of the costal cartilages.[1]

With the same object in view Cimbali of Siena[2] has successfully practised intercostal massage in conjunction with the use of compressed air. The massage is carried out by rubbing with firm pressure the greased chest in the intercostal spaces of the affected side, from vertebral column to sternum, two or three times a day. Apart from the revulsive action on the skin, this probably exerts a directly stimulant action on the pleura.

In the way of medicinal agents the claims that have been recently presented in favor of antipyrine should not be forgotten, especially as this remedy has proved of such marked benefit in the first stage. Clement of Lyons (May 10, 1891) states that, whether fever be present or not, he at once administeres antipyrine, without any other medication whatever. In all cases there was, on the following day or at latest the day after, a marked reduction in the height to which the dulness reached. In some cases the dulness disappeared after forty-eight hours' treatment, and in two or three the fluid was completely absorbed in twenty-four hours. In no case was the effect delayed beyond four days. The dose given was, as a rule, 6 grammes (90 grains) a day—1 gramme (15 grains) every four hours. After absorption of the liquid the treatment should be continued for some days longer, in order to prevent relapse, the daily dose being, however, reduced to 4 grammes.

We have elsewhere stated that we doubted that this treatment would prove always efficacious, its value being almost exclusively limited to the truly rheumatic cases; nevertheless, the matter is too recent to be entirely dismissed without further experience.

[1] Vide *Dobell's Reports*, 1876, 1877.

[2] *Lo Sperimentale*, Oct., 1885.

If in spite of the preceding treatment and better diet the effusion still lingers or increases, the value of an exclusive *milk* régime should be tested. MM. Serre, Eloy, and others[1] have claimed with some show of reason that absorption of the fluid in pleurisy can be obtained far more readily on a simple milk diet than by diuretics, drastics, and blisters. It causes a notable increase in the amount of urine excreted, and the dyspnœa decreases in direct proportion to the increased diuresis. The authors state that the milk treatment is adapted to the treatment of pleuritic patients who can afford to wait, the effect being obtainable only in four or five days. The milk may be given fresh or boiled, hot or cold, pure or mixed with aromatics, with soda, or with mineral water, but in any case the diet should be restricted to milk as a base. It should be taken by mouthfuls every hour or hour and a half, the quantity ingested in the twenty-four hours being from three to six pints. It should be continued for some days after the disappearance of the exudation, to avoid recurrence, and then the usual diet should be returned to by degrees. "Thus managed," M. Eloy asserts, "the treatment becomes one of the most powerful hydragogues destined to replace thoracentesis. In some cases the urethra may take the place of the trocar."

Notwithstanding this great praise, the present writer believes that the milk treatment is much more likely to prove efficacious in cases of simple hydrothorax due to cardiac or renal lesions, where, in conjunction with digitalis, potassium iodide, and salines, it is without doubt the dietetic article *par excellence*.

The same confidence that has been displayed in the milk treatment (*régime lactée*) in France has been given to dry diet in Germany. This dry diet, consisting of the use of *dried* food with the total suppression of liquids, is almost identical with the dietetic treatment of thoracic aneurism originally recommended by Bellingham and Joliffe Tuffnell of Dublin. In Germany, where it is referred to as Schroth's treatment, it was, and is still, adopted in many clinics through Niemeyer's recommendation. Pimser reported 11 successes in 18 cases. He limited the food of the patient to lean roast veal and stale rolls, kept him two days without any drink, and not until the third day allowed ½ a pint of red wine—on the seventh and eighth a whole pint. The urine decreases considerably under this treatment. Not many patients will have the will and the energy necessary to submit to such a cure, which, as Fräntzel says, seriously impresses the whole constitution. The writer has tried both this dietetic plan of Schroth and the less cruel one of Tuffnell in the wards of the Charity Hospital and in private practice, without results sufficiently brilliant to justify a continuance of the treatment.

[1] *Rev. gén. de Chir. et de Therap.*, Sept. 20, 1888.

It is probable that in the matter of diet much will depend upon the patient, a restricted fluid or fasting dietary being indicated for the more robust and plethoric patients, while a substantial, and even stimulating, *ménu* will be most beneficial in the poorer and anæmic class of subjects. Water in any case should be given sparingly, and preferably in the shape of milk.

In addition to the foregoing dietetic measures, the administration of a saline purgative, especially a concentrated watery solution of Epsom or Rochelle salt (1 to 3 ounces), early in the morning, as recommended by Matthew Hay, is advisable. Potassium bitartrate, compound jalap powder, and other equally vigorous purgatives may be selected, though none of them can be relied upon so much as the concentrated Epsom-salt solution first mentioned. When a very prompt and decided purgative impression is desired, probably nothing equals the following:

℞. Elaterii, gr. ½;
Ext. hyoscyami, gr. j.—M.
Ft. in pil. No. 2.
Sig. Take one pill and repeat in two hours if the effect of first dose is not sufficient.

The effect of the elaterium is much improved by the combination, the hyoscyamus making it far more tolerable to the stomach and less griping.

In the way of securing elimination by diuresis the means at hand are very unsatisfactory. The potassium salts, especially the acetate, citrate, and bitartrate, spiritus ætheris nitrosi, and the vegetable diuretic infusions are so notoriously unreliable in this condition that it is almost unnecessary to disturb the patient's stomach by administering them.

The efficacy of caffeine in serous effusions of cardiac origin, now universally recognized, led MM. Huchard, Jaccoud, Comby, and others to try this drug in sero-fibrinous pleurisies.[1] In a case treated by Comby, in which 2.5 grammes of caffeine citrate, with the same quantity of sodium benzoate, were given in twenty-four hours, together with milk diet, the excretion of urine increased from 600 to 2000 grammes in the twenty-four hours, and the signs of effusion rapidly disappeared.

Doubtless, much more superior and reliable than the above for all cases in which a positive diuretic effect is desired is diuretin, or the double salicylate of sodium and theobromine (natrium theobrominum salicylicum, Merck). This diuretic, since its introduction by Gram of Copenhagen, has won for itself a very distinguished position in the diuretic group. It is certainly possessed of great energy, but, unfor-

[1] *Rev. gén. de Clin. et de Thérap.*, Apr. 25, 1889.

tunately, its efficacy is mainly displayed in the removal of those dropsical accumulations which result from circulatory disorders, especially of heart disease. Nevertheless, if any diuretics are to be tried to remove the effusion of pleurisy, this is the one to be selected. Koritschoner, Schrotter, Nothnagel, and other representative Viennese clinicians have fully sustained the diuretic value of diuretin in hydrothorax. In one case reported by Koritschoner[1] the dropsical pleura of a patient with Bright's disease was entirely drained out in the course of one night, and the evacuation was so rapid that the patient suffered as intensely as if he had been aspirated, violent cough, hæmoptysis, intense pain, and almost general collapse accompanying the sudden exit of the fluid.

The smallest efficient dose of diuretin that should be administered in twenty-four hours is 4 grammes (1 drachm); the average dose is from 4 to 6 grammes (1 to 1½ drachms), and the maximum dose 8 to 10 grammes (2 to 2½ drachms), in the course of twenty-four hours. As a rule, diuretin is well supported by the stomach, even when its administration is prolonged for months. In a patient under the author's care who had taken diuretin over three months the only disagreeable effect was a slight burning of the stomach. Koritschoner and others prefer to administer the drug in an aqueous solution. The author administers it in capsules or wafers, giving 8 to 10 grains every two hours, or 6 grains every hour, at least two hours after meals.

Much has been said in favor of the diuretic action of calomel, alone or combined with digitalis, in dropsical affections, since the earliest days when Graves and Stokes first recommended it. Nowhere has calomel—and, in fact, the whole mercurial class—received greater praise than in the treatment of serous inflammations, pleurisy in particular; and yet in no other condition does the present writer believe that it has more signally failed to sustain this unmerited reputation. This opinion is based on the recollection of the early clinical attempts to verify the reputed good results of the mercurials in pleurisy; the disastrous consequences which so frequently developed as a result of hydrargyrism soon causing the author to limit their services to the simple purgative effect of calomel.

However, the use of the oleate of mercury (10 per cent.) by inunction, or rubbed over the affected side by the massage method of Cimbali, may prove of some benefit if there is any truth in the so-called *aplastic* action of mercury on fibrinous exudations. But if it is resorted to at all, care should be taken with the mouth, the first sign of gingivitis or stomatitis calling for an immediate suspension of the remedy.

Of other remedies that may be tried to remove the sero-fibrinous exudation, we need only mention the alkalies, which, Bartholow[2] be-

[1] *La Semaine médicale*, Oct. 15, 1890.

[2] *Practice*, p. 372.

lieves, are the only agents which possess the property of dissolving exudations, the most efficient of them being ammonia. Carbonate of ammonium can be best given, according to this author, in a solution of the acetate (5 to 10 grains in ½ to 1 ounce), or in the following formula if there be an associated cough with some expectoration:

℞. Ammonii carb., ʒj;
Aquæ lauro-ceras., ℥ss;
Syrup. lactucarii, ℥j;
Syrup. senegæ, ℥j;
Syrup. tolutani, q. s. ad ℥ij.—M.
Sig. One table-spoonful every two hours.

In addition to the purgative and diuretic agents previously mentioned, diaphoresis may also be resorted to with advantage by means of the hypodermic injection of ⅛ grain of any of the salts of pilocarpine. L. Michau of Paris at one time reported excellent results in the removal of serous effusion with the infusion of jaborandi. The later reports of Crequey, Grasset, Lequesne, and Wermaere would appear to sustain the value of this remedy, though a conscientious experimentation with the drug has given the author only negative and disappointing results as far as the cure of the effusion is concerned.

Our objections to counter-irritants in the advanced or chronic cases of pleural exudation have been stated elsewhere. In the earlier weeks of the effusion some benefit may be obtained from the local application of the compound tincture of iodine, fly blisters, or the use of the following very irritant solution known in the New York hospitals as Corson's paint:

℞. Olei tiglii, ʒij;
Ætheris, ʒiv;
Tinct. iodinii comp., q. s. ad. ʒij.—M.
Sig. To be painted over the affected part with a camel's-hair pencil every morning.[1]

Nevertheless, when the effusion, after reaching the fourth week, still resists the internal remedies and the dietetic measures previously recommended, it will not be affected by external embrocations, and the practitioner will do better by proceeding to the evacuation of the rebellious effusion by aspiration.

Thoracentesis.

For a long time, even after the introduction of improved apparatus, it was claimed that thoracentesis in pleurisy was only an emergency

[1] S. Mitchells, *Therap. Gaz.*, Nov. 16, 1885

operation, simply intended to relieve the urgent asphyxial phenomena resulting from an excess of exudation. Like tracheotomy in croup, it was the forlorn hope of an exhausted treatment. Yet as far back as the days of Trousseau we were taught that in the evacuation of pleural effusions we possessed something more than a palliative procedure, and that, in fact, it was the most effective measure given to us to promote and secure the radical absorption of serous effusions; and time has confirmed the truth of this teaching.

We may now state that the indications for the puncture of the chest and evacuation of pleural effusions are based upon—1st, the abundance of the effusion; 2d, the rebelliousness of the effusion to absorption in spite of appropriate medication.

Conditions which Demand Immediate Evacuation.—(*a*) Whenever the effusion is excessive and is accompanied by symptoms of asphyxia, such as orthopnœa, cyanosis, etc., then there is urgent danger, and the fluid must be aspirated at once. (*b*) Whenever the exudation is excessive and fills the whole pleural space, even when there are no symptoms of asphyxia, then large accumulations are dangerous, because by suddenly displacing or twisting the root of the heart, or otherwise interfering with the thoracic circulation, they may cause instantaneous death.

But what must we consider as an excessive or immediately dangerous quantity in the absence of subjective symptoms? Trousseau and Dieulafoy regarded two to two and a half quarts as dangerous; and the researches of the latter have shown that death has never been caused by quantities less than two quarts, except in the fatal case of Blachez, in which the pleura did not hold more than two quarts. By what signs can the presence of a dangerous quantity be recognized? It may be stated, in a general way, that in these cases all the respiratory sounds are replaced by absolute silence; the respiratory murmur and vocal resonance are everywhere abolished; there is complete dulness or flatness on percussion, from the clavicle in front or the supraspinous fossa behind to the lower edge of the costal arch below. The apex of the heart is displaced to the right or left; the liver and spleen are depressed; the chest is dilated; the intercostal spaces bulge; the walls are occasionally œdematous. A better test than all this is the evidence furnished by the result of a puncture with the long, fine needle of a hypodermic syringe, which will not only determine the nature of the fluid, but also decide as to the precise height of the effusion. We may safely say that in all cases in which fluid is detected on a level with the second rib immediate evacuation, irrespective of other considerations, is called for and must not be delayed.

Conditions which Permit Delay.—"With good resonance down

to the third rib, and with no material enlargement of the side, we may assume that, although much fluid be present, the lung is only held in the position of physiological rest, and that, therefore, operative interference is not called for" (Powell).

Whenever the effusion is only moderate in quantity, the indications for puncture and evacuation are only to be drawn from the resistance of the liquid to absorption. In acute pleurisy the febrile period has always been regarded as unsuitable for surgical intervention. It is always a wise plan, for the reasons given elsewhere, to abstain from interference during the febrile stage, unless a very rapid and dangerous increase in the effusion, in spite of medication, calls for symptomatic relief. Nevertheless, as Moutard-Martin clearly demonstrated, "fever has no bad effect on the final progress of the effusion, and a puncture made during its course is liable to cause a fall of the temperature to normal." Potain observed that the fever fell and disappeared completely from the second to the fifth day in 25 cases of acute pleurisy in which thoracentesis was resorted to at this early date. Widal,[1] who is an enthusiastic advocate of this practice, says: "There is nothing surprising in these results when we consider that to puncture during the febrile state is to puncture early—*i. e.* when the lung is still free from adhesions and expands easily, since it has not had an opportunity to contract incurable attachments." Behier operated, in fact, on the ninth or tenth day, the moment that defervescence took place. Webber goes still further and punctures his patients during the first week, the fever notwithstanding, and greatly extols the results obtained by this method. It is best, however, to adopt a middle course, and to operate only after complete defervescence, when, after a reasonable trial of medication and diet, it is manifest that the exudation shows no disposition to be absorbed spontaneously, and that the case will enter into a chronic stage unless relieved.

In left-sided pleurisies the course of the exudation must be watched with great care, the displacement of the heart taking place much more rapidly. Evidence of cardiac displacement should here immediately call for aspiration.

In the aged, thoracentesis is more often a palliative operation, as the pleurisies which require it are most frequently of a secondary and complicated character. Especial caution in performing the operation slowly is demanded.

The acute pleurisies of childhood rarely require aspiration unless they become purulent. The non-purulent or simple sero-fibrinous exudates are so promptly and effectively disposed of by nature that operative intervention is, as a rule, superfluous.

Whatever may be the ultimate effects of thoracentesis upon the

[1] Art. "Pleuresie," *Dict. Dechambre.*

cure of the pleurisy, the operation always secures for the patient immediate and very marked relief. As fast as the fluid is evacuated and the lung unfolds and expands, the inspirations gain in depth, the percussion notes become clearer and resonant in the anterior region of the thorax, then posteriorly, and above; if the heart has been displaced, it does not remain in its abnormal situation, but gradually returns to its proper place, provided it be not bound down by adhesions.

The auscultatory phenomena confirm the preceding data. The temperature is frequently elevated shortly after the operation; it may even attain 104° on the day of the puncture, but the next day returns to normal (Widal).

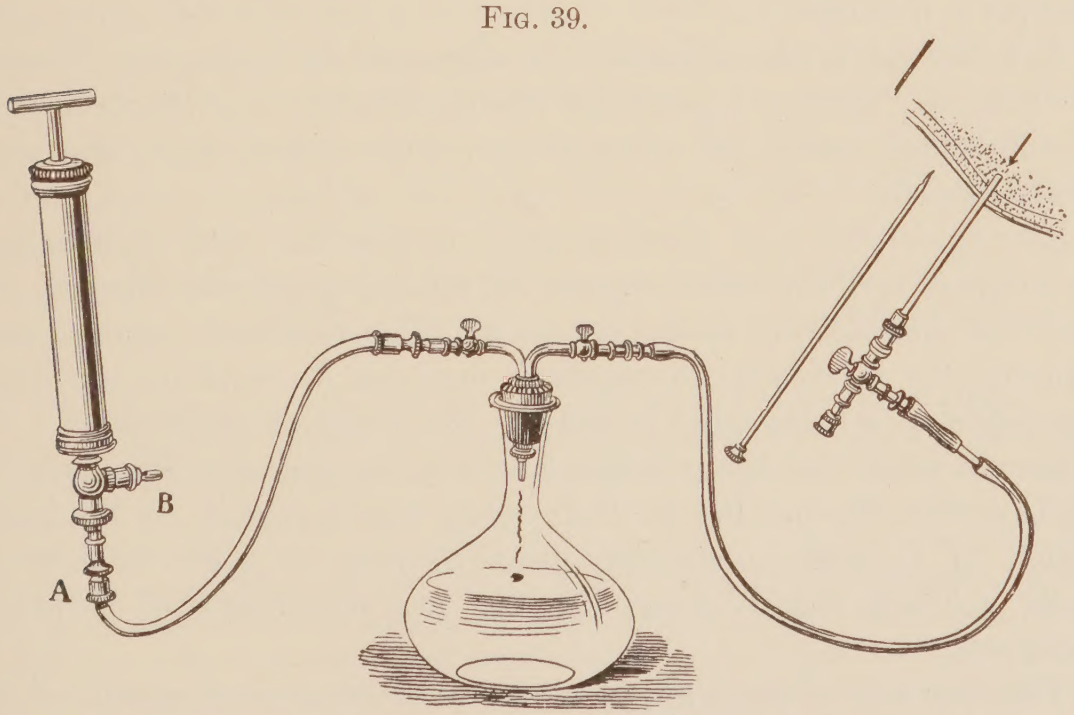
Mode of Operating.—The therapeutics of pleurisy exhibit nowhere more conspicuously the beneficent influence of modern progress than in the mechanical means that have been invented for the safe removal of the fluid products of this type of serous inflammation. In glancing over the history of thoracentesis we notice that the knife, which was first used, promptly gave way to the hot iron, and this to the trocar. This instrument, which was a deadly weapon in the hands of the older surgeons, helped, with the aid of the fatal consequences following its use, thoroughly to discredit the operation.[1]

It was not until the trocar was essentially modified by the ingenuity of Reybard that thoracentesis became a less formidable operation. The simplicity of Reybard's apparatus, and the security which it ensured in preventing the entrance of air, made it the most popular instrument for the evacuation of the pleural contents, its practical utility having been proven so continuously by the brilliant results obtained by Trousseau, to whom we are profoundly indebted for his great work in popularizing the operation and rescuing it from the disrepute into which it had fallen. At present, thanks to the introduction of the method of aspiration by Bowditch of Boston (1852), and the subsequent pioneer efforts of Dieulafoy in France, Raumussen in Denmark, and Mayne in England, and lastly to the advent of Listerism and asepsis, the operation of thoracentesis has been so perfected that it may now be regarded as a practically innocent operation. Thoracentesis is at present always performed with very fine hollow perforated needles or trocars attached to aspirators of some modern pattern. Dieulafoy's and Potain's are, in our opinion, the best aspirating apparatus yet invented, in spite of the thirty odd modifications of them

[1] "Boyer operated several times, and never saved a single case. Dupuytren had only 2 successful cases in 50. He said that his patients should die by the hand of God, rather than by the hand of man. Sir Astley Cooper had only one successful case. Gendrin not one in 20 cases. Davis saved two-thirds of his cases. The eminent W. W. Gerhard of Philadelphia looked upon the operation as nearly always attended with fatal results. What a contrast to modern views and clinical results!"—(F. Donaldson, art. in Pepper's *System*).

that have been introduced. They are nearly all worked on the same principle—the close vacuum operation, and the withdrawal of the fluid by aspiration. Bowditch employed a syringe with a double stopcock (Wyman's, Weiss's); Flint recommends the Davidson syringe. The bottle aspirators of Potain, Castiaux, or Raumussen commend themselves, especially for their simplicity and cheapness, the last a great point in favor of their general adoption. The Allen surgical pump, a recent candidate for favor in the United States, is also an admirable instrument, very ingenious, and simple in its construction. It has found many advocates, and is used extensively in the West. We have not had very extended experience with it, but presume that it can be utilized as well as the other and older apparatus mentioned. We can only say that as long as an instrument will readily secure a vacuum, can be cleansed without difficulty, and is readily transportable, it will meet all the requirements. We must, however, stop to consider one point which is common to all instruments, and that refers to the puncturing agents. All aspirating needles, unless guarded, as in Fitch's dome trocar or Castiaux's or Robert's protected point, should be rejected as positively dangerous. The point of the unprotected needle is liable to wound an expanding lung, to injure the diaphragm or pericardium, and to convert a simple pleurisy into a hæmothorax or pneumothorax. These results rarely occur in experienced hands, but they constitute a real element of danger, which can only be guarded against by using a trocar, such as has been adapted to the aspirating apparatus by Potain

FIG. 39.

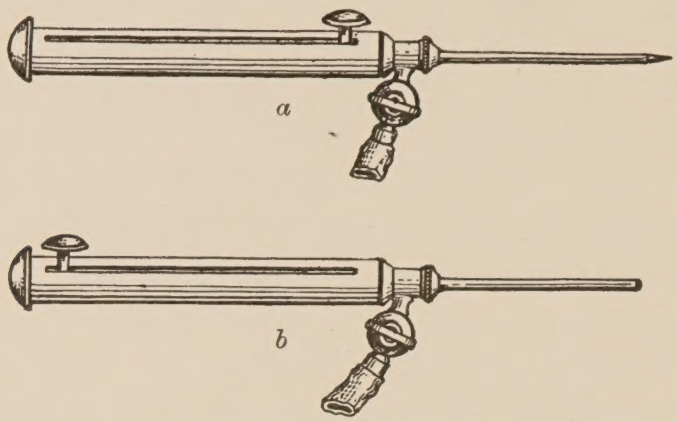


Potain's Aspirator: Galante model trocar, with stylet withdrawn.

(see Fig. 39) or Fräntzel (see Fig. 40). By the use of these trocars not only are the above dangers avoided, but what is a very great advan-

tage is gained—viz. the ability to clear the canula of any obstructing fibrinous plug without repuncturing the patient. The plugging of the

Fig. 40.



Fräntzel's Trocar: (*a*) with projecting stylet; (*b*) with stylet withdrawn.

canula in aspiration is of frequent occurrence, especially in acute inflammatory effusion, and has always constituted one of the most annoying accidents of the operation; all this is avoided by either of the trocars mentioned.

We need not refer to other methods of evacuation which have been introduced with the view of supplanting aspiration. The syphon method (Fiedler's or Southey's), which has received considerable commendation in some quarters, has been tried by the author, but with great disappointment, and promptly abandoned. It may do in simple hydrothorax, but in cases of effusion with much flocculent exudation it is simply a nuisance.

As to the subcutaneous pleurotomy suggested by Kogerer of Vienna, by which this operator expects the pleural effusion to empty itself into the subpleural connective tissue, it is of more illusory advantage than practical worth.

Having decided that the evacuation by puncture and aspiration is the simplest and the safest means of removing pleural effusion, we must now consider the *modus operandi*. The first and essential step is thoroughly to cleanse the aspirator and test its working condition. The next step is thoroughly to sterilize the trocar or needle-point. If we bear in mind that the greatest danger in the operative treatment of simple serous effusions lies in their ready contamination by the introduction of pyogenic micro-organisms through a septic or unclean canula, we will readily appreciate the vast importance of antiseptic precautions.

The best way of sterilizing the needles or trocars and canulæ of the aspirator is to boil the trocar and canula separately for twenty minutes in a solution of 1 drachm of sodium bicarbonate to a pint of water; then, after drying, keep them permanently immersed in a sterilized bottle

filled with absolute alcohol. This recent suggestion of Dawbarn of New York is of positive value, not only in keeping the instruments aseptic, but also free from rust. The plan was originally suggested for the preservation of surgical needles, but I have extended its application to much larger instruments, as in this instance.

Another plan is to wash the needle, trocar, or canula in an alcoholic or watery solution of carbolic acid, 5 to 10 per cent., taking special care to wash the trocar and canula separately. After washing, the needle or trocar should be heated thoroughly over an alcohol flame, and cooled by dipping in the carbolic solution just mentioned. Debove has gone so far as to invent a special sterilizing stove for his trocars, which can be heated to 120° C., but this is unnecessary. In addition to this, a warm carbolized solution (5 per cent.) should be aspirated through the tubing attached to the trocar, in order to make more certain the purification of the instrument.

Having thus prepared the apparatus, our attention should now be directed to the patient. Here, again, the first object of our solicitude should be the securing of an aseptic surface. Warm water with German green soap or the bichloride soap (Bergmann's formula) of Steifel & Co. is an excellent means of cleaning the surface. If the surface has not been irritated by blisters or counter-irritants, bathing the surface with ether and alcohol, and finally wiping with absorbent cotton soaked in a 5 per cent. carbolic acid solution, will complete the antiseptic preparation of the surface.

The next question is where to puncture. The point of election for aspirating the chest has given rise to much discussion.[1] There is no classical point of election. The selection of a site for puncture should be governed by at least three considerations: 1st. Quantity of the fluid and the height reached by its upper level; 2d. The displacement of the vital organs, especially the heart and diaphragm; 3d. Presence or absence of adherent lung.

We should also bear in mind that as we leave the axillary line, to move either forward toward the sternum or backward toward the spine,

[1] Laennec punctured the fifth interspace just above the sixth rib at a point midway between the axillary and mammary lines, or preferably near the latter. This is adopted by Fräntzel, Wolliez, P. Barbille, etc. Cruveilhier advised the third and fourth interspaces as being the points selected by nature in spontaneous evacuation. Trousseau preferred the sixth interspace in the mid-axillary line on the right, and the seventh intercostal space on the left side; this is also Douglas Powell's selection. Professor Marshall would choose the anterior weak spot in the fifth space, nipple line. Another weak spot preferred by some operators (Beaumetz) is in the posterior axillary line, on a level with the lower angle of the scapula. Maurice Reynaud claimed that the seventh middle intercostal spaces were the columns of Hercules that guided the operator to a safe entrance into the chest. Bowditch recommends the posterior wall of the chest, as low down as possible between the ninth and eleventh ribs. Dieulafoy advises the eighth intercostal space, on a level with the inferior angle of the scapula.

the dangers of the puncture increase. The nearer we approach the vertebral column, the narrower become the intercostal spaces and the thicker the thoracic parietes. If we approach near the sternum, we are more liable to puncture the pericardium or heart, especially in the encysted or areolar pleurisies, in which the cardiac displacement is more likely to occur; and if we puncture too low, the liver or spleen may be injured. At all events, the vertical anterior or mid-axillary line is the safest; "if the fluid is excessive, we can operate as high up as the fifth intercostal space on the right side, and the seventh on the left. If the chest is two-thirds full, we can take the seventh or sixth intercostal space on the right side, and the eighth on the left. If only one-third of the cavity is occupied by fluid, we can go as low as the eighth intercostal on the right, and on a level with the scapula in the axillary line on the left side. If the quantity of fluid is so great as to force the abdominal viscera, especially the liver and spleen, below their normal position, we may be safe in puncturing below the seventh intercostal space. Aran plunged a trocar into the liver when operating in the seventh intercostal space; Claude Bernard impinged upon the peritoneum at the same point." Without being exclusive the author would advise, with Donaldson, "when there are no contraindications the sixth intercostal space in the mid-axillary line;" it is out of reach of the diaphragm on both sides, and is accessible when the patient lies on the side, which the writer prefers; the space is also sufficiently wide and the parietes thin.

In dealing with fat or œdematous walls the advice given by Professor Peter[1] is good. In these cases counting the ribs is no easy matter, and the best plan "is simply to aim at an intercostal space in the axillary line, situated at the point of junction of the lower with the upper two-thirds of the thorax."

Having now thoroughly tested and sterilized the apparatus, cleansed the surface of the chest, and finally settled upon the precise spot where the puncture is to be made, and, above all, being certain of the correctness of the diagnosis, we must proceed to the operation proper by anæsthetizing the proposed seat of puncture. This is a matter of considerable importance with many, if not the majority of, patients. The best means of effecting this is by the subcutaneous injection of 5 or 10 drops of a 4 or 5 per cent. solution of the hydrochlorate of cocaine in water. This will secure perfect painlessness in the introduction of the trocar. It is certainly more efficacious than the use of the ether or rhigolene spray or the ice-and-salt applications of Douglas Powell.

In the majority of cases when a fine No. 1 needle trocar (1 millimetre calibre) is used, no preliminary local anæsthesia is required, as the pain is trifling. General anæsthetics or analgesics, such as

[1] *Leçons cliniques*, p. 638.

morphine, are, as a rule, not only contraindicated, but absolutely unnecessary. In some cases the patient may find comfort in a preliminary drink of whiskey or brandy. A light meal two or three hours before the operation is usually a good preliminary (Donaldson). Whiskey, ammonia, digitalis, and camphor should always be at hand to be exhibited in case of complications, especially to relieve the fainting feeling that often overcomes the patient while the aspiration is in progress.

When all is in readiness the patient should lie in a semi-recumbent position (neither the horizontal nor upright position is advisable), with the arm corresponding to the affected side bent over the head, so as thoroughly to expose the side. The skin should now be drawn up, and the nail of the left index finger of the operator should be pressed well in the interspace, so as to serve as a conductor to the aspirating trocar. The finger will better guide the penetrating instrument by pressing thoroughly upon the interspace for a few seconds, the main point to avoid being the lower edge of the overlying rib, under which course the intercostal vessels and nerves, which must be avoided; on the other hand, the point of the trocar should distinctly avoid the upper edge of the lower rib, for fear of striking the bone, and thus embarassing most annoyingly the first step of the operation. Having struck the intercostal space in the centre, the trocar or needle should be thrust boldly into the pleura with the point directed rather downward than upward, for fear of injuring the lung; the instrument should be sharply pushed in, and not thrust in with a slow, boring motion. Some authors recommend the preliminary puncture of the skin with a lancet to diminish the resistance of the surface, but this precaution is only needed when the larger needles or trocars are used.

The diminished resistance which is usually felt after a penetration of one or two inches indicates that the cavity has been reached, and that it is time to withdraw or conceal the trocar-point, and to proceed to the aspiration of the liquid proper. Upon turning the stopcock a small vacuum, created by preliminary aspiration, will immediately cause the fluid to flow into the receiving cylinder (Dieulafoy's) or bottle (Potain's) of the apparatus used. As the fluid flows the aspirating force should be only sufficient to draw it out slowly and gently. It is well to stop for a few minutes after aspirating about four ounces to watch the effects. "The fluid, running in a very small stream, will give the lung time to accommodate itself to its altered condition. The lung by this process is led rather than forced to resume its normal position" (Donaldson).

It often happens, particularly when aspirating the effusion of acute pleurisy, that large fibrinous coagula obstruct the canula, and that the flow of the fluid is arrested. Here the advantages of using the trocar

of Potain or Fräntzel become manifest: the stylet or trocar, which has not been wholly removed, is carefully pushed in again and the canula cleared of the obstructing embolus. Beaumetz and others object to this secondary use of the trocar and prefer to repuncture the chest, on account of the supposed danger of air-contamination; but with a well-constructed trocar like either of those recommended the admission of air can be surely guarded against, and the inconvenience and pain of a new puncture avoided. Clearing the canula by forcing back a regurgitant current from the aspirator, as recommended by Bowditch and others, is even more dangerous, because the fluid already aspirated may be the carrier of some particles of septic or unclean matter concealed in the tubing or aspirating receptacle.

Having begun to aspirate, the next question is to determine when to stop the aspiration. The amount to be withdrawn must vary according to many circumstances peculiar to each case. "Our rule," says Donaldson, "has been to draw off more when the pleurisy is acute than when it is chronic. The long continuance of the fluid in the cavity has so impaired the lung's capability of expansion by the adhesive bands that compress it that the sudden withdrawal of a large quantity is often attended with risk. If the patient bears the operation well, we may remove much more than if the contrary is the case. The amount withdrawn at the first operation should be from eight ounces to sixteen ounces in a child, and twelve ounces to twenty-four ounces in an adult." The complete evacuation of the pleura is not necessary. A partial evacuation, to start the absorbents into activity by diminishing the excessive intrapleural tension resulting from excessive fluid, is all that is required.

With the object of obtaining precise data as to the amount of intrapleural tension during thoracentesis, and thereby regulating the quantity of liquid abstracted, many clinicians have adapted the manometer to their aspirating apparatus. Preference should be given to the simplest models, such as Peyrot's and Leyden's. The manometer allows the observer to follow directly the rate of tension-reduction and the degree of aspiration, and in this way avoid those ugly and at times fatal accidents which follow the too rapid or sudden diminution in the intrapleural tension. Potain has laid down the rule that the aspiration must be stopped whenever the manometer indicates that the intrapleural tension is inferior to that of the atmosphere. We believe, however, with Schreiber and almost all observers, that "the manometer only complicates the operation without sufficient compensatory advantages, and that the physiological phenomena which promptly indicate the existence of dangerous tension-reduction are even safer indices than the manometer," and for this reason we need not dwell further upon it.

One point is of the utmost importance: the needle should be instantly withdrawn at the onset of dyspnœa, chest constriction, much cough, or any tendency to syncope. These symptoms are warnings we should never neglect. This is the time to administer stimulants.

After the removal of the desired quantity the needle is withdrawn with a sharp, quick pull. The skin is allowed to fall and obliterate the track of the puncture, and the orifice of the latter is closed with either a small strip of adhesive plaster or a little cotton pledget soaked in iodoform collodion (5 per cent.)[1]

Complications and Dangers of the Operation.—The simplicity and benignity of modern aspiration, whenever practised with ordinary precautions, are so amply proven by experience that no statistical evidence need be quoted to prove a fact so universally admitted. Suffice it to say, that in a practice of over ten years' duration in the wards of the New Orleans Charity Hospital—an institution which annually ministers to the ills of over 20,000 patients—and in which the puncture and aspiration of the pleura was probably performed over one hundred times a year, I have never witnessed or heard of a fatal accident occurring during its performance. That complications and ugly symptoms do present themselves quite often during the operation is undeniable, especially when aspiration is pushed to extremes by an over-zealous or inexperienced operator, who, not heeding the warnings of the patient, rashly carries his efforts at complete evacuation to unnecessary and dangerous limits.

Among the accidents of thoracentesis we should mention—*a*, injury to the intercostal vessels; *b*, injuring the rib; *c*, puncture of the liver, spleen, heart, and lungs; *d*, plugging of the needle or trocar with fibrinous coagula, causing "dry" puncture or failure to aspirate; *e*, admission of air; *f*, cough-paroxysms, due to pulmonary fluxion; *g*, constrictive thoracic pains, due to eccentric distension of pleural and pulmonary adhesions and painful concentric retraction of thoracic walls.

The more specific complications which at times very seriously encumber this simplest of operations are—

Albuminous Expectoration.—This accident may vary in intensity—

[1] With the view of preventing reaccumulation, Drs. Cayla, Picot, and Gourichon (*Journ. de Méd.*, Paris, May, 1885) have recommended that aspiration should be immediately followed by the systematic application of the thermo-cautery over the affected surface. The cauterizations should be very numerous, from one to two hundred, and not be distant from one another more than half an inch, and they should always extend beyond the limits of the pleural effusion. They should be made by simply touching a pointed hot iron to the skin, so as to make a minute cauterized point.

The method proved particularly beneficial in the acute and early cases, which, as a rule, do well under simple aspiration. In the chronic cases it has apparently given fair results. While little confidence can be placed in it, nevertheless it is worth remembering in the treatment of the obstinate chronic cases, as we shall see later.

very insignificant at times, very serious at others. In the first instance the patient may be seized by a paroxysm of cough and thoracic oppression followed by slight serous or sanguinolent expectoration, which may end in five or ten minutes. In the more dangerous examples of this complication the cough is paroxysmal, the anxiety and cyanosis increase, and the patient expectorates mouthfuls of a serous liquid which may vary in quantity from two ounces to two quarts. The liquid expectorated, on settling, separates into two strata—the upper frothy, and the lower showing an albuminous precipitate. Auscultation reveals the fine crepitant râles of œdema at the base of the lungs. The suffocation and dyspnœa attending this last condition may last a few hours or a whole day. In some cases, fortunately very rare, this untoward complication ends in death.

This accident is not due, as was at first supposed, to a formation of a pleuro-bronchial fistula, permitting the escape through the mouth of the pleural exudation (Fereol), but, as demonstrated by Herard, Moutard-Martin, and Dujardin-Beaumetz, it is due to pulmonary congestion; sometimes it may be due, as Legroux and others contend, to the cerebral and bulbar anæmias which are the consequence of the great afflux of blood to the compressed lung which is being relieved from pressure by the aspiration. In order to avoid this congestion and its consequences Dieulafoy has given this well-known and excellent advice: Never to withdraw at one aspiration more than 1000 to 2000 grammes of liquid, especially if the pleurisy is an old one. By following the advice already given in the preceding pages while dealing with the technique, this accident will rarely, if ever, occur. It is a notable fact that in the last few years, since the technique of the operation has been better understood, deaths from this complication are seldom recorded.

The medical treatment of this complicating congestion consists in the exhibition of stimulants, counter-irritants, and derivatives, particularly venesection, the efficacy of which has been proven more than once.

Sudden Death during Aspiration.—The cases of sudden death due to syncope or asphyxia which have been reported as occurring in the course of thoracentesis exercised at one time a discouraging effect upon the practice of this operation. The rigorous analysis of the facts, and the special study of the individual cases by such conscientious investigators as Leichtenstein, Bowditch, Toussain, Dieulafoy, and Donaldson, have proved conclusively that these unfortunate results were not attributable to the operation itself, but to the conditions under which it was practised.

Conditions of the Lung following Aspiration, and their Treatment.—Three things may happen after the partial or complete evacuation of the pleural contents: 1st. Immediate cure by the com-

plete absorption and non-reproduction of the effused fluid. 2d. After a partial evacuation the remaining fluid may be more or less rapidly reproduced, to be again absorbed never to return. 3d. The liquid evacuated may be again replaced by new exudation. The first two results may be invariably depended upon, and characterize the course of acute, simple, and uncomplicated or primary pleurisy when treated by early aspiration. The third class of cases, which are characterized by a rapid reproduction of the effusion, demanding repeated evacuation, are only observed in chronic pleurisies, and are, as a rule, indicative of a complicated condition, tuberculosis of the pleura being the special etiological factor to be suspected. We must also observe, in most of these cases in which the effusion is reproduced with great rapidity and abundance, that not only tubercle is to be suspected, but the advent of suppuration *is to be anticipated.*

Chronic Pleuritic Serous Effusions.

Not a few cases are still from time to time met with in which one side of the chest is distended with fluid, the effusion dating from an attack of pleurisy months, or even a year, previously, and which, on removal, proves to be perfectly limpid and serous. This is particularly observed in cases of so-called latent pleurisy. Douglas Powell relates an interesting case of a policeman, "stalwart-looking enough to frighten thieves," who for over four or five years had his left pleura completely full of slightly turbid serum. After a few partial tappings it became evident that no expansion of the lung could be looked for, and in the absence of urgent symptoms it was not thought prudent to subject him to radical treatment. Powell, with Wilson Fox, does not believe that an effusion will become purulent from mere lapse of time, but the author concurs with many others that, in view of the existence of many avenues of infection and the readiness with which pyogenic micro-organisms may contaminate an originally strictly serous exudation, there is always danger of purulent transformation in these chronic cases. Furthermore, it is well recognized that perfect recovery in the very long standing cases is well-nigh impossible by resorting to simple operation, the lung having become bound down and thickened by long-continued compression. With Powell, again, the author believes that there will always be a certain small number of cases in which the lung is from the first coated by an exudative layer of unusual thickness and uniformity, which, as pointed out by Walshe, contracts forcibly and aids the fluid in bringing about collapse of the lung. Such a membranous layer affords a serious impediment to absorption, and is apt to undergo a degree of organization which renders the contraction of the lung a permanent condition. Under these circumstances, and in a strongly-built adult chest (as in the case of the policeman above quoted),

a large pleural space remains which it is almost impossible to obliterate, and which must be occupied by some kind of effusion.

What should be the conduct of the medical adviser when confronted with such a case? When the contained fluid has undergone purulent transformation or is primarily purulent, the operative relief that surgery would prescribe is clear. Estlander's operation or Schede's thoracoplasty would solve the problem in some measure by allowing the chest-walls to sink in, and secure the obliteration of the cavity. But when the effusion is still serous, are we justified in resorting to similar procedures? The question has not been sufficiently debated to permit us to generalize and establish a guiding rule of practice, but, believing that the presence of fluid in the chest would always be a menace to the life of the patient, either by its liability to sudden increase, its purulent transformation, or by its effect upon the lung, we would advise aspiration, followed by the subperiosteal resection of several ribs, as has been done by Dr. Westbrook of Brooklyn[1] for this very condition. This is a safe operation, for it would not open the pleura to infection, since the ribs would be resected subperiosteally.

We may state, in a general way, that the cure of pleurisy is never complete: after the evacuation of the fluid the primitive friction-sounds indicative of the approximation of the pleural surfaces are heard. These finally disappear, and with their cessation we are informed of the occurrence of the adhesions which intimately and permanently bind together the parietal and the visceral pleuræ, thereby obliterating the pleural cavity proper.

Against these pleural adhesions, whether they be secondary to a sero-fibrinous pleurisy or they be primary, as in the so-called "dry" pleurisy, the materia medica has little to offer. The secondary revulsives, blisters, iodine, and the internal exhibitions of mercury and the iodides, which have been advised, are mere placebos, the use of which is usually followed by disgust and disappointment to both patient and physician.

Much more satisfaction will be found in carefully attending to the general hygienic and dietetic conditions. A course of systematic respiratory gymnastics, general and local massage, will prove practically beneficial for the correction of the deformities of the thoracic and vertebral skeleton, which not only disfigure the chest, but encroach upon the respiratory capacity of the patient.

The use of compressed air by means of the pneumatic cabinets now in use in this country, or a course of mountain-climbing, will probably give the best results in securing the final restoration of the lung itself and the nearest possible approximation to its normal expansion.

[1] *N. Y. Med. Journ.*, March 12, 1887.

Varieties of Pleurisy.

While the fundamental indications in the treatment of all forms of non-purulent pleuritic inflammations are well covered by a thorough appreciation of the therapeutic principles laid down in the body of this article, there are nevertheless such distinct departures from the typical pleurisies which have been here considered that a brief notice of the most marked and eccentric variations is necessary.

TUBERCULAR PLEURISY.

First in order of importance is tubercular pleurisy. We must distinguish between primary tubercular pleurisy and that which develops secondarily as a result of extension from the lung. Primary pleural tuberculosis may be localized or disseminated. If localized, it will usually present the characteristics of "dry" or plastic pleurisy, rarely developing into the typical sero-fibrinous type. If, on the other hand, the deposits are multiple, then a sero-fibrinous pleurisy will develop, which will be most difficult to differentiate from the typical *a frigore* or non-tubercular variety. There is no doubt that this form of tuberculosis is exceedingly common; certainly much more so than was taught some years ago. The frequency with which tubercle was found in the anatomical and clinical researches of Landouzy, Kelsch, and Vaillard led to the generalization that all idiopathic primary pleurisies were of tubercular origin. While the contention of these investigators is far from being proven, it nevertheless indicates the vast importance of this variety, and the care that must be exercised before concluding as to the nature of even the simplest cases that come to us for treatment. It is not always an easy matter to establish conclusively the tubercular or non-tubercular origin of a given case of pleurisy. Much was expected from bacteriological research since Koch's discovery of the bacillus, and still more from the diagnostic reaction of his tuberculin. The real blessing that would have been conferred upon us by the last has unfortunately proved an illusion; and as to the test presence of the tubercle bacillus in the secretions—a test which is so valuable in other localities—it is also denied us. The recent researches of Fränkel, Weichselbaum, Ehrlich, Netter, and Koplik prove that in the vast majority of cases of exudative pleurisy in which the clinical facts would suggest the presence of the bacillus this micro-organism is conspicuous by its absence. Therefore, in the absence of the actual demonstration of the bacillus, we must depend solely upon the lessons of experience, which teach that all pleurisies in which this effusion constantly and rapidly returns after aspiration, and in which the aspirated fluid presents a sanious character, must be regarded as due to tubercular deposit.

In marked contrast with the failure of bacteriology to furnish a diagnostic test is the valuable assistance furnished by physical signs; not in the primary pleurisies proper, but in those secondary tubercular pleurisies which are developed early and coincidently with the first deposits in the pulmonary parenchyma. Thanks to the later studies of Grancher and his followers, which are familiar to all students of physical exploration, the presence of tubercle in a lung surrounded by even a large exudation can be detected with comparative ease.

The recognition of this last condition now opens the question as to the attitude of the practitioner in a case in which a large effusion compresses a tubercular lung. The question is a difficult one, and has not been satisfactorily answered. Powell[1] states: "As long as a chronic effusion does not give rise to any serious displacement of other viscera or to danger symptoms, it should be preferably left undisturbed." We believe, however, with Beaumetz and others, that when the effusion is recognized early, the expansion of the lung, which is secured by prompt aspiration, is more likely to restore the lung to a better physiological condition, thereby assisting Nature in preventing the further evolution of the disease in the lung.

While the effusion in tubercular pleurisy is more frequently clear and strictly serous or *sanious*, it may become purulent or puruloid at the least provocation, either through contamination with pyogenic micro-organisms or through the superficial necrosis of the granulation membrane. This superficial necrosis of the granulation membrane, as Kelsch and Vaillard have shown, is a frequent cause of intrapleural hæmorrhage; in fact, tubercle by this process is one of the most frequent causes of hæmothorax. Generally, however, the hæmorrhage in these cases does not exceed 800 or 1000 grammes (Vidal), and is often the precursor of ultimate purulent changes. At any rate, as Dieulafoy and others have shown, the removal of the effused blood by aspiration leads often to permanent cure of the pleurisy.

Finally, in the chronic tubercular cases, in which the lung is hopelessly bound down by adhesion, and which remain unaffected by aspiration, and in which the patient's general condition is good, it is possible that curetting the pleura or resecting the diseased membrane, together with tamponing, as has been done successfully by Schede and Kuester, may be the only means of securing radical relief. As far as the medicinal treatment is concerned, it is the same as that recommended for pulmonary tuberculosis.

RHEUMATIC PLEURISY.

In striking and agreeable contrast with the preceding is the rheumatic type, which is essentially characterized by the rapidity of its

[1] Third American edition.

appearance and disappearance. It may assume the very acute plastic or the subacute sero-fibrinous type, but in any case it rarely becomes chronic. The vigorous administration of the analgesic antithermics, antipyrine, phenacetin, acetanilide, or salol, or the salicylates, with morphine, promptly relieves the most acute symptoms and ensures very satisfactory relief. If there is some stubbornness to absorption of the exuded serum in the later stages, potassium iodide, with the syrup of the iodide of iron and arsenic, and slight counter-irritation, will usually accomplish the desired results. A favorable formula is—

℞. Potassii iodidi, ʒij ;
Syrup. ferri iodidi, ʒiij ;
Liq. hydrarg. et arsenii iodidi, ʒj ;
Syr. avenæ phosphatis, *vel* syr. zingiberis, q. s. ad. ℥viij.—M.
Sig. Table-spoonful three times daily for an adult.

HÆMORRHAGIC PLEURISY.

This is never a primary or specific type of pleural inflammation, but is a secondary epiphenomenon which is frequently added to other more distinct and independent varieties of pleuritis, and as such is of sufficient importance to deserve separate consideration. If the word "hæmorrhage" were translated in a literal sense, all acute pleurisies would be hæmorrhagic, because almost all the exudations of acute pleurisy contain a considerable number of red blood-corpuscles. A serous effusion may contain as many as six thousand red cells to the cubic millimetre of effusion, and still this will remain perfectly limpid to the naked eye (Dieulafoy). If the number of cells increases, however, the liquid will become rose-tinted, and finally blood-colored. The difference between the two will simply be that the first is only a histological hæmorrhage, while the last will be grossly or clinically a true hæmorrhagic extravasation. This difference is also of prognostic and therapeutic importance, for, as shown by Dieulafoy, a *histologically* hæmorrhagic pleurisy will almost invariably become purulent, while a true hæmorrhage into the pleura or into a serous effusion consequent upon secondary causes (tubercle, cancer, etc.) never becomes purulent.

With Widal, the chief causes of inflammatory hæmothorax may be grouped into—1st, an exaggeration of the inflammatory (hyperæmic) phenomena in certain acute sero-fibrinous pleurisies ; 2d, hæmatoma of the pleura ; 3d, pleural tuberculosis ; 4th, cancer of the pleura ; 5th, certain general systemic conditions ; 6th, too violent aspiration during thoracentesis.

In the variety of hæmorrhagic pleurisy which is indicated by the first cause the hæmorrhage is due to the rupture of the pleural capillaries under the strain of excessive inflammatory fluxion. This is the

only condition to which the designation of primary hæmorrhagic pleurisy is strictly applicable. In these cases the exudation is rose-tinted, and finally blood-colored, from the very start, differing in this way from those sero-fibrinous pleurisies in which the exudation is clear and still histologically hæmorrhagic. In the first instance, when the hæmorrhage results from the great intensity of the inflammatory action, the prognosis is good, because the effusion is almost invariably absorbed spontaneously, and recovery takes place early; in the other variety purulent transformation, as previously stated, is the rule.

Pleural tuberculosis may give rise to hæmorrhagic pleurisy in two ways—by the degenerative or ulcerative changes of the granulomatous deposits of acute miliary tuberculosis, but much more commonly by the superficial embolic granulation necrosis of Kelsch and Vaillard, which has been referred to in the section on Tubercular Pleurisy. In addition to all tubercular infection other forms of pleurisy may give rise to hæmatomatous exudation, just as hæmorrhage may occur in pachymeningitis cerebralis or spinalis, and in hæmatocele of the tunica vaginalis.

Cancer is likewise a frequent (according to the older authors the most frequent) cause of pleural hæmorrhage. But we need not linger longer on these etiological conditions; suffice it to say that, as a rule, the majority of hæmorrhages which complicate the inflammatory affections of the pleura are either spontaneously absorbed or permanently removed by cautious aspiration. Internal treatment, especially directed to control the hæmorrhage, is very seldom, if ever, required.

URÆMIC PLEURISY.

This condition frequently develops in the course of chronic renal disease, and is of toxic origin. While it is inflammatory in character, and should be distinguished from the simple dropsy of the pleura that frequently accompanies this morbid condition, the treatment is essentially the same as in hydrothorax. It is mainly eliminative. Saline purgatives, especially Epsom salts (Matthew Hay's method), the saline diuretics, pilocarpine, and digitalis, are especially indicated. Diaphoretics will also give great assistance. Iodine as a counter-irritant may be applied, but blisters or cantharidal collodion are entirely contraindicated. The general tonic and dietetic treatment of renal disease is of course of primary importance.

CARDIAC PLEURISY.

This variety has been especially studied by Bucquoy. It is not to be confounded with the double hydrothorax that occurs in the later or anasarcous stages of heart disease. This condition is more often connected with aortic lesions, is a truly inflammatory condition, and

accompanies the earlier stages of heart disease. Its treatment is the same as that of ordinary primary pleurisy, though it is in the main subordinated to the general and graver condition which underlies it.

PLEURISIES OF UTERO-OVARIAN ORIGIN.

The intimate lymphatic connections which exist between the pleuræ and peritoneum not infrequently lead to the apparent metastatic production of inflammatory affections in the pleura when these exist in the pelvic organs. These forms of pleurisy may result, as shown by Potain, from direct or lymphatic contamination or by reflex fluxion. As a rule, they are limited to the same side as the affected ovarian region; they are usually of a subacute character, and the exudations are absorbed spontaneously. Denons has also called attention to the coincidence of frequent serous effusions with large ovarian cystomata. These effusions are more probably of a dropsical than inflammatory character. At any rate, they disappear with the removal of the disease.[1]

PRIMARY SYPHILITIC PLEURISY.

This very rare manifestation has been recently described in an instructive study by Nikouline of Moscow.[2] The history of the case, and the fact that the pleuritic manifestations, exudation, etc. prove rebellious to all other than antisyphilitic treatment, are the only means of diagnostic differentiation. In the cases reported by Nikouline, potassium iodide, with mercury, produced a very marked effect in the temperature, and caused a rapid disappearance of the friction-sounds, etc.

DIAPHRAGMATIC AND OTHER LOCAL PLEURISIES.

The influence of the region involved is nowhere better exhibited than in diaphragmatic pleurisy. This condition, which was at one time regarded as an independent entity and designated by the terms phrenitis or diaphragmitis (Lieutand, Cullen, Stoll, Portal, Frank, and others), is characterized by the development of pain and dyspnœa of peculiar intensity, and which finds no analogy in other pleurisies. The pain occupies either the right or left hypochondrium, and radiates toward the epigastrium. The pain is at times very acute, and is markedly aggravated by inspiratory movements as well as by pressure in the painful regions. M. Gueneau de Mussey's *bouton diaphragmatique* is, like McBurney's point in appendicitis, a helpful associate sign. This painful point is situated in the epigastrium at the point of intersection of two lines, one horizontal, beginning at the osseous tip of the tenth rib, and the other vertical, which is continuous with

[1] Widal, *loc. cit.*

[2] *R. Medicina*, Dec. 28, 1890.

the right border of the sternum. Very painful singultus and very intense dyspnœa, with freedom from physical signs, complete the diagnostic sketch of this formidable condition.

The only means of relieving the patient's profound distress is by the free exhibition of morphine hypodermically in ¼- or ½- grain doses, repeated every two hours until the symptoms are subdued. Counter-irritation by blistering is also in order, together with the internal exhibition of antipyrine, antifebrin, or phenacetin. The application of the restraining band of Otto, if the painful state of the lower chest will permit it, is indicated. The band should be applied low down, to favor thoracic respiration and diminish the abdominal and diaphragmatic movements.

INTERLOBAR PLEURISY.

Interlobar pleurisy is most frequently secondary, and simulates pulmonary abscess. The exudation usually becomes empyæmatous, and finds its way out through the bronchi. The breath is markedly fœtid if evacuation by the bronchial route takes place, and the aromatic deodorants—as eucalyptol, menthol, or thymol—are indicated, both by inhalation and by hypodermic injection, dissolved in oil of vaseline or hot olive oil, as recommended by Roussel in phthisis. A good inhalant is the following:

℞. Creasoti, ℥ij;
Menthol., ℥j;
Eucalyptol., ℥j;
Chloroformi, ℥ij;
Aquæ Cologniensis, ℥ij.—M.

Sig. Thirty drops to be inhaled from a Welch or Yeo respirator every two or three hours.

This will do much good if associated with proper internal treatment, especially creasote, terpin hydrate, terebene, cod-liver oil, etc.

ENCYSTED PLEURISY.

The encysted pleurisies, which have been so well studied by Jaccoud, are characterized by very marked displacement of the internal organs, the heart especially, in those accumulations which occupy the anterior half of the left pleura. Aspiration in these cases is not followed by the best results, the effusion returning rapidly. In aspiration great caution should be observed not to puncture the displaced organs (the heart particularly), as has happened in several well-authenticated cases (Guirginshon, Dieulafoy). Experience appears to be in favor of counter-irritation preventing recurrence of effusion. Not only blisters.

but the potential and actual cauteries, as applied by the ancients (Broussard, Monneret, Larrey), may be followed by surprising results, according to the trustworthy evidence of A. Martin and Professor Peter.

EMPYÆMA, OR PURULENT PLEURISY.

The advent of suppuration in the pleura implies a radical change in the whole nature, as well as therapeutics, of the pleuritic process; furthermore, with the recognition of pus in the pleura the pharmacological resources of medicine must retire to the background, and the aggressive intervention of surgery must dominate in the treatment. For this reason a separate consideration of this variety of pleurisy is essential.

Etiology is much more intimately connected with the treatment of the purulent than with the non-purulent pleurisies. In the non-purulent varieties the inflammatory reaction of the pleural serosa is limited to plastic and serous transudation and new tissue-formation. In the purulent variety, in addition to these three conditions, there is a progressive shedding of embryonal endothelial elements, which, with the migrating leucocytes and other formed elements of the blood, constitute the pus of the exudate. Modern bacteriological investigation has almost conclusively determined that this *progressive* suppuration is solely due to the irritation of pyogenic bacteria and their products. This, therefore, is the cardinal difference between the purulent and non-purulent forms. While many of the non-purulent forms are due to pathogenic micro-organisms which are not pyogenic, the presence of pus in the pleura must always coincide with the presence of pyogenic bacteria or of both species (mixed infection).

Again, while all purulent pleurisies are of microbial origin, the bacteria which cause them may be of different species, and, being endowed with specific properties, they cause likewise different manifestations of their activity in the pleura.

With some insignificant exceptions, bacteriology has classified purulent pleurisies into at least four distinct varieties: 1st, those due to pneumococci (*Diplococcus pneumonicus*, Fränkel and Weichselbaum); 2d, to the *Streptococcus pyogenes;* 3d, those due to saprogenic organisms; 4th, those due to Koch's bacillus.[1]

The following figures indicate the relative frequency of these four great species: Pneumococcus pleurisy (usually metapneumonic pleurisy), 32 in 109 cases, or 29.5 per cent.; streptococcus pleurisy, 51 in 109

[1] *Vide* Netter, *Transact. Soc. Méd. des Hôpitaux*, May 16, 1890; *La Semaine médicale*, May, 21, 1890.

cases, or 46.8 per cent.; saprogenic or putrid pleurisy, 15 in 109 cases, or 13.7 per cent.; tubercular pleurisy, 12 in 109 cases, or 11 per cent. Netter estimates that over two-thirds of all empyæmas are due to infection with pneumococci and the strictly pyogenic micro-organisms. The statistical observations of Rosenbach, Weichselbaum, Fränkel, Renvers, and Koplik confirm the preceding studies.

The pleurisies due to pneumococci are most frequent in children, the streptococci species in the adult. In children Netter observed that 53.6 per cent. of the cases were due to pneumococci, and 17.8 per cent. to streptococci; in adults 53 per cent. were due to streptococci, and 17.3 per cent. to pneumococci.

The prognostic as well as operative indications furnished by the different micro-organisms are important. The pneumococcus is a comparatively benign organism, and has no progressively destructive or pyogenic tendencies. Consequently, the empyæmas with which it is associated are the most amenable to treatment. The metapneumonic pleurisies are almost invariably due to pneumococci. So are the empyæmas of childhood. In these cases, aspiration is sufficient, or, in the event of failure by this means, antiseptic pleurotomy will almost invariably be followed by prompt recovery.

The empyæmas that are associated with the streptococci and staphylococci have a progressively destructive tendency. They are never spontaneously absorbed, and always require free pleural incision and drainage, with careful antiseptic precautions. These agents frequently contaminate primary pneumococcal and tubercular pleurisies, and add to them their progressively destructive tendency. They are the chief mischief-makers in the acute purulent pleurisies which complicate scarlet fever and the other exanthemata, osteomyelitis, pyæmia, etc. In saprogenic or putrid pleurisies the aseptic pleurotomy with evacuation is by itself insufficient, and antiseptic irrigations are mandatory.

The positive diagnosis of the species of pleurisy is made by bacteriological examination. It requires no more than three days at furthest for the examination of the non-tubercular varieties. It may be delayed much longer in the tubercular varieties when the simple morphological examination does not reveal the presence of Koch's bacillus, which is, as a rule, recognizable only in 1 out of 4 cases, according to Netter's and Fränkel's experience. The very fact, however, that in a purulent exudation microscopical examination reveals the absence of micro-organisms is the best *prima-facie* evidence of its tuberculous character. If an absolute diagnosis is required, however, then, in the absence of the bacillus, the inoculation test practised on guinea-pigs is the only *positive* way of demonstrating the tubercular nature of the exudate.

In view, however, of the difficulty at times of obtaining a bacteriological examination, the gross appearance of the pus, coupled with the

previous history and other antecedents, will usually permit the attendant to come to an approximate conclusion as to the exact nature of the exudate. We may thus distinguish, with Germain Sée—

1st. A fibrino-purulent exudation. This liquid has a large quantity of fibrin in suspension, in the shape of either flocculi or pseudo-membranes. It has a slightly greenish tinge, and is more puruloid or puriform than strictly purulent. This exudate characterizes the true metapneumonic pleurisies and the infantile pleurisies. It is associated mainly with the pneumococcus. It will become thicker (more purulent) if staphylococci and streptococci develop in it.

2d. A sero-purulent exudate. This is the pus that is found in the empyæma of the infectious diseases or in consequence of contamination of an originally strictly serous effusion with a septic or unclean instrument. It may be faintly turbid or of a greenish creamy color; it may also be chocolate-colored when there is a great admixture of red corpuscles. This kind of pus is always associated with the strictly pyogenic micro-organisms already mentioned.

3d. The putrid and gangrenous varieties are recognized easily enough by their odor and appearance.

4th. The tubercular pus is not always so easy to identify, especially when the pyogenic micro-organisms are mixed with the tubercle bacillus in the pathogeny. In the unmixed varieties the pus has precisely the same sanious, watery appearance that characterizes the exudate in ordinary *cold* abscesses.

While the nature of this contribution and the limitations of space will not permit us to enter into a discussion of the mode of entrance of these micro-organisms into the pleura, it follows from the anatomy of this serosa that, except in penetrating wounds, its infection must always be secondary to other pre-existing microbic contaminations, whether these be localized in the lungs or other tissues, or in the blood. At any rate, the important practical question presented for consideration is how to recognize the presence of pus in the chest, in order that we may deal with it in accordance to the etiological and clinical indications. In the majority of the cases the symptoms and physical signs do not differ materially from those of fibro-serous pleurisies. Sometimes, however, they do, and this is according to whether they are acute purulent or chronic purulent pleurisies. In acute purulent pleurisy the disease commences in the same way as the ordinary acute fibro-serous pleurisy. Indeed, the first effusion is ordinarily serous in appearance, and afterward becomes purulent. A marked characteristic is that in acute purulent pleurisy the fever persists in spite of treatment; the effusion increases, sometimes less rapidly than in the serous variety, but in a continuous manner. If exploration with a hypodermic needle is performed about the eighth or tenth day, we notice that the fluid is opales-

cent and contains a large quantity of pus. If the fluid is aspirated, it is subsequently reproduced, and as the pus forms the fever continues; the skin is hot and dry, the appetite impaired, and sweats appear during the night. In examining carefully the thoracic walls we find œdema of the affected side. Later on there will be œdema of the lower extremities.

Chronic purulent pleurisy is marked by symptoms somewhat different. It commences in a similar manner to acute pleurisy, with fever, but in a few days the fever disappears. In the evening there may be some febrile action with slight chills. It is remarkable that frequently vast collections of purulent fluid do not give rise to chills. The fluid augments progressively, sometimes slowly; often it appears stationary for a long time. This condition continues sometimes for months. The patient is pale and feeble. Increasing dyspnœa interferes with locomotion. Anorexia is complete. Anæmia is most marked. Œdema of the chest-walls, followed by diarrhœa and general anasarca, with or without albumin in the urine, appears. If Nature does not open an orifice through the parietes of the chest or through the bronchi for the discharge, the patients finally succumb in the last degree of wasting, with profuse sweats and fœtid colliquative diarrhœa.

Bacelli's sign—the non-transmission to the ear of the whispered voice through the chest-walls (aphonic pectoriloquy)—is probably one of the most important physical signs of purulent transformation. This sign is, of course, only added to all the other signs of fluid effusion which are furnished by physical exploration, and which are referred to in the section on Sero-fibrinous Pleurisy.

But the positive diagnosis always rests on demonstrating the presence of pus by exploratory puncture with an ordinary hypodermic needle. Frequently, however, the hypodermic needle is too small for the purpose, especially in dealing with the thicker exudates, like those which are found in the metapneumonic empyæmas, and the larger needle of an exploring syringe is required.

In exploring the chest for diagnostic or therapeutic purposes it should be borne in mind that the needle should be inserted in a direction corresponding to the centre of the intercostal space, consequently in an oblique direction from below upward. If no contraindications present themselves, the exploratory puncture should be made at a place where, later, the radical operation will be performed, if this should be finally required. If the needle is made aseptic by the precautions given in the section on Thoracentesis, no harm will result from not merely one but many explorations, even should the lung or liver be punctured.

Presuming that the diagnosis of empyæma has been made, the three leading therapeutic indications to be met are—1st, to evacuate the pus already formed; 2d, to prevent the reproduction of another accumula-

tion ; 3d, to restore as quickly and completely as possible the normal condition (anatomical as well as physiological) of the respiratory apparatus.

As a rule, the first of these indications requires surgical intervention. Spontaneous absorption, it is true, may be produced under certain circumstances : it is not even rare in the metapneumonic pleurisies, when the inflammation is due exclusively to pneumococci. But whenever other pyogenic micro-organisms (streptococci, staphylococci, and tubercle bacilli) participate in the pathogenesis, it is impossible for spontaneous resorption to take place, owing to the resistant vitality of these pyogenic agents. It is mainly owing to the complicating presence of the latter that empyæma owes its progressive character ; and it is, as a rule, indispensable to interfere by operation.

As previously stated, internal medication is totally powerless in the presence of empyæmatous accumulations, experience having demonstrated more than conclusively that all the reputed sorbefacients or resorbents are absolutely worthless for the purpose. The spontaneous cystic encapsulation of the pus, which at times renders its presence less dangerous, is a rare event, and, on the other hand, the spontaneous evacuation of the pus may be followed by the most serious consequences, no matter by what route effected. Therefore, all thoracic pus-accumulations demand evacuation by surgical means.

The second indication—*i. e.* to prevent the reaccumulation of the pus—can only be met by operative procedure, which will permit the constant and thorough discharge or drainage of every particle of the old and new pus-formations.

The third indication, which calls for a *restitutio in integrum* of the anatomical and physiological conditions, remains still a desideratum in many cases. This is particularly the case with patients in whom the lung suffers from irreparable lesion coincidently with the empyæma (as in tubercular cases), in cases of complicated pyo-pneumothorax, and even in the simple chronic cases in adults in which the lung has been permanently bound down by inelastic adhesions. In all these cases the cure, if possible, must remain only partial, even after the most extensive operations. It is therefore important to establish, approximately, in advance and in each case, the limits of success that may be attained by therapeutic interference, and to weigh carefully the risks to be incurred on the one hand and the results that may be expected on the other before undertaking any definite procedure. When this sort of prognostic calculation leaves a balance unfavorable to the patient, it is preferable to abstain from inflicting unnecessary and even dangerous traumatisms of doubtful utility, and to limit our assistance to palliative treatment.

On the other hand, in the simple and recent cases we should be

prompt and energetic in our interference, for in these cases operative treatment is rewarded by the most happy and perfect results. Here, nevertheless, a certain conservatism is judicious. We should begin always by the less mutilating procedures, reserving the major operations for the more rebellious cases, in which all other considerations are subordinated to the final saving of the patient.

Passing now from the general to the concrete, let us consider the various procedures that the advanced technique of modern surgery places at our command to meet the aforesaid three indications.

These measures resolve themselves into—1, simple thoracentesis with aspiration; 2, aspiration with antiseptic irrigation; 3, continuous or permanent drainage into a vacuum, or syphon drainage; 4, perrigation by through-and-through drainage; 5, radical operation (antiseptic pleurotomy), with or without costal resection; 6, multiple rib-resection; 7, osteothoracoplasty, with or without pleurectomy (Schede).

1. *Simple Thoracentesis with Aspiration,* as practised for the removal of non-pleuritic effusions (*vide* Thoracentesis), is a procedure that is applicable only to those cases of empyæma which are exclusively due to pneumococci; in other words, to the empyæmas of children. In these cases the purulent collection has a natural tendency to recovery, either by spontaneous absorption or by evacuation. Even in these cases, however, aspiration frequently fails, and resort must be had to the more radical operation. Still, the frequency with which aspiration is followed by recovery in the infantile cases justifies its continued use in pædiatric practice. It should be remembered, however, that if the first aspiration is followed by reaccumulation we should immediately resort to antiseptic pleurotomy, and not follow the teaching of the older authors, who insisted upon repeated tappings. Antiseptic pleurotomy in the pneumococcal empyæma of children is not only an easy operation, but one almost invariably followed by success. In fact, the inherent tendency to recovery in the purulent pleurisies of children, owing to the flexibility of young ribs, is so great that evacuation, by no matter what means, is almost always followed by recovery.

2. *Simple Aspiration, followed by the Injection of Antiseptic Solutions,* has given some good results, but exceptionally only, and always in cases in which the natural tendency to recovery is great, as in children. Parker, and more lately Baelz, Kushimura, Fernet, and others, have reported favorable results with various solutions, such as those of quinine, salicylic, boric, and carbolic acid, weak sublimate solution, chloral, chloride of zinc, naphthol and creolin, etc. None of these agents should be allowed to remain in the pleural cavity, for fear of toxic phenomena. We do not linger over this practice, for it is not only dangerous, but almost invariably disappointing when compared to the

other methods to be described. It is a method that has more of historical than practical interest.

3. *Constant Drainage by Syphon Action, with or without Antiseptic Irrigation*, has as its main object the securing of constant drainage of the purulent products without incurring the risk of air-contamination. At one time this mode of treatment was quite popular in France, when, owing to the introduction of Potain's syphon, the method was easily carried out. Lately there has been a revival of this practice in Germany, where, under the name of Bülan's method, it has found extensive application. While, *a priori*, syphon drainage would appear to be an ideal practice, experience teaches that it is often most disappointing and fallacious. Immermann of Bâle, who is one of the most distinguished advocates of this practice, admitted at the Ninth German Congress for Internal Medicine (April 15, 1890) that "this method gives good results only in recent empyæmas in which the pus is not too thick, notably in double empyæmas, in which we should avoid the formation of a bilateral thoracic fistula. In the metapneumonic pleurisies, in which the pus is very thick (and loaded with flocculi) and there are many adhesions, evacuation of the pleural contents by this method is frequently not only quite difficult, but impossible. As to the empyæmas in which there is a large excess of pus, the danger of septic absorption is too great to permit of slow evacuation, and the radical operation (pleurotomy) must be performed.

We may say, therefore, in a general way, that the syphon method may be adopted only in recent cases in which the expansile power of the lungs is not lost, and in which a preliminary aspiration reveals the presence of a thin, liquid, inodorous pus, free from large flocculi or fibrinous masses; it should be reserved exclusively for adults or older children who can receive the constant attention of an intelligent nurse.

Of the various apparatuses that have been designed upon the syphon principle, the Potain and Bülan contrivances are the best known, and deserve special mention:

"Potain's ingenious instrument, based upon the syphon principle, enables us alternately to empty the pleural cavity into a basin of water and, by reversing the instrument, to inject the sterilized or antiseptic solution (sterilized salt water preferably, 1 drachm to the pint) into the pleural cavity, thus washing out, as often as necessary and with ease, the purulent collection and cleansing the cavity.[1] Potain's syphon is composed of an india-rubber tube 30 centimetres in length, to be introduced and remain in the pleural cavity. This tube is introduced through the canula, after the withdrawal of the trocar, to the depth of at least 20 centimetres, in order that its extremity should reach the posterior wall,

[1] We shall subsequently refer extensively to the contraindications of irrigation in the pleura when dealing with Pleurotomy.

the tube having been previously filled with antiseptic solution. The outer extremity is put into a basin containing water. The part of the tube at the outside of the orifice is closed by a *serrefine*, or clamp, just beyond the shield, as is also the extremity in the water. Another tube is connected with the chest portion. This can be used for introducing warm *sterilized* salt water (1 drachm to the pint) preferably, or other mild antiseptic solutions, to wash the pleura. The syphon of Potain has very decided advantages over the metallic or hard-rubber drainage-tubes. It prevents the introduction of air, and enables us completely to empty the cavity (in the proper cases) as frequently as is necessary, without pain, without change of position or fatigue to the patient; and this prevents attacks of coughing. All this is done slowly, and the flow can be arrested at any moment by means of the clamps. When repeated washings are required the patient himself can perform them with ease."[1]

The so-called Bülan method is based on the same principle that guided the construction of the syphons and subaqueous drains of Playfair, Pugge, Goodhart, and F. H. Williams of Boston, and is practised as follows: "A thick trocar is thrust in between the ribs, and the moment it is opened a disinfected draining-tube, which exactly fits in the canula, is passed into the pleural cavity as far as possible, and closed by a clamp. The canula is then carefully extracted, and a second clamp applied to the tube between it and the thorax, when the first clamp is removed and the canula slipped off. The rubber tube, which should be a metre and a half long, is now attached to a glass tube which passes through a rubber cork almost to the bottom of a bottle partly filled with some antiseptic solution. The bottle should also have a mouth-piece, through which any necessary suction may be made should the draining-tube become clogged up in any part of its course. The patients are soon able to go about carrying their bottle with them."[2]

In order to hold the drainage-tubing in the chest and prevent it from slipping, a perfect antiseptic dressing consisting of iodoform gauze and bichloride absorbent cotton should be carefully packed around the tube, which should be held in position by being drawn, as L. Powell of Toronto has suggested,[3] through a small hole punched in a piece of strong rubber bandage, which is fastened around the chest over the dressing.

At the Ninth Congress of German Physicians (April, 1890), already referred to, Immermann reported that in a collection of 57 cases treated

[1] F. Donaldson, Pepper's *System of Medicine.*

[2] Immermann, *Annual of the Universal Med. Sciences*, vol. iii., 1888.

[3] *Vide Ibid.*

by Bülan's method in Hamburg, Gratz, and Basle, 49 cases, or 86 per cent., were directly cured by it.[1]

The methods thus far described, while attempting the complete evacuation of the pleural contents, aim also at the exclusion of the atmosphere, and for this reason must be classed together under the designation of the *closed methods.*

4. *Perrigation by Through-and-through Drainage.* The attempts at open drainage, as originally practised by Chassaignac, Kidd, Banks, and lately Michael, aim at the continuous evacuation of the pus by means of single or double openings in the chest at different or opposite points, selected with the view of securing the advantage of gravity, etc. This method—which is also known as *perrigation,* when the tubes are situated at opposite points, so as to allow injections of antiseptic fluids to irrigate the whole pleural space—has become almost obsolete in the practice of the day. The principles of antiseptic and aseptic surgery have been better understood, and experience has amply confirmed the fact that under the ægis of listerism the old Hippocratic operation of pleurotomy by free incision into the pleura was, after all, the only certain and secure way of evacuating the pleural cavity of all pus and necrotic débris.

5. *Antiseptic Pleurotomy* is, in fact, the most rational way of dealing with all kinds of purulent accumulations in the pleura. By giving a ready large exit to all purulent accumulations not only does it secure a thorough evacuation of the pleura, but it ensures their constant outflow as well, thus most effectually preventing their accumulation. While the danger of septic infection very justly deterred the older operators from resorting to it as the initial operation in empyæma, the remarkably favorable statistics that have accumulated since the introduction of listerism have demonstrated that by the addition of antisepsis and asepsis this once formidable operation has now become the safest and speediest way to restore the health of an empyæmatous patient. With Senn[2] we believe that it is a good plan in every case to combine aspiration with exploration, for purposes of improving the conditions for a radical operation. By aspiration we demonstrate the presence and kind of pus in the pleural cavity, and by removing the fluid completely or in part we aid the expansion of the lung, which, by the time the radical operation is performed, will probably have become adherent lower down. Aspiration is to be followed in the course of two or three days by a radical operation. The operation for empyæma must always be done with the strictest antiseptic precautions, as any mistake or negligence in this regard is exceedingly

[1] *Vide* also "A Plea for Syphon Drainage," by G. Bülan, *Zeitschrift für klinische Medizin,* Dec., 1890.

[2] *Principles of Surgery,* 1890, p. 283.

liable to be followed by infection with putrefactive bacteria—an occurrence which would greatly increase the danger from sepsis.

We have already given some hints as to the antiseptic details to be adopted in the performance of simple thoracentesis; it is now still more important to follow these details here. The preparation of the patient's skin and the sterilization of the instruments and dressings require special attention. We have been in the habit of sterilizing our material with the aid of an Arnold steam sterilizer, and subjecting both instruments and dressings to a moist temperature of 212° F. for over half an hour. Only newly-sterilized sponges that have not been previously used or mops of sterilized gauze are used for wiping the surface. The skin is best prepared by thoroughly washing the affected side with warm water and German green soap, then ether or alcohol are used to remove the fatty matter, and finally a hot sterilized towel, dipped in 1 : 1000 sublimate, is laid over the seat of operation. The hands and nails of the operator should be scrupulously cleaned and brushed by Fürbinger's method or in the manner recommended for the patient's surface. The instruments—bistouries and scalpels, dissecting and artery forceps, retractors, periostome, sequestrum forceps, bone-gouge forceps, Liston's bone nippers, drainage-tubes, etc.—should be dipped in a porcelain pan containing 5 per cent. carbolic-acid solution.

The question of anæsthesia now follows. In children it is almost impossible to operate without a general anæsthetic. In adults a general anæsthetic (chloroform or ether) is always indicated unless the condition of the patient is such as to contraindicate its administration. Whenever the patient is much exhausted it is preferable to resort solely to local anæsthesia by injecting a 4 per cent. or 5 per cent. solution (aqueous) of hydrochlorate of cocaine subcutaneously along the proposed line of incision.

Shall the incision be made simply between the ribs, or shall the pleurotomy be preceded by a partial costectomy?

In children simple incision without resection is, as a rule, sufficient. In adults the removal of a piece of rib must be recommended in all chronic cases (*a*) in which the lung is bound down by adhesion and cannot be expected to expand readily; (*b*) in which thoracic deformity has caused an excessive approximation of the ribs, with a narrowing of the interspace; (*c*) in cases in which the preliminary aspiration reveals putrid or offensive pus.

The positive excision of a rib has for its object the securing of a large orifice that will not contract too readily, especially when the sinking of the chest wall takes place after the drainage of the accumulation. As in the metapneumonic empyæmas healing takes place promptly as a rule, it is preferable in such cases not to resort to this practice. In

almost all the other varieties of pleurisy, owing to the fact that they are usually due to the more resisting pyogenic cocci, it is best to resect the rib. In the primary tubercular variety, or that due to the opening of tubercular cavity in the pleura, it is best to abstain from intervention if the patient is weak, or to operate by the still more radical procedure to be described later if the favorable condition of the patient justifies it.

The site of the incision is a question of importance. In empyæma, even more than in simple pleurisy, the point of election has been the subject of great controversy.

In cases in which the pus has already perforated the thoracic wall and presents itself as a subcutaneous abscess (*empyæma necessitatis*), it is simply necessary to open the collection at the most prominent or bulging point by a horizontal incision parallel to the ribs. In the absence of this indication the rule laid down by Godlee is the safest. As the retraction of the diaphragm is more rapid than the retraction of the lung, the opening in the thorax should be, as he teaches, as high as the centre of the effusion. This usually corresponds to the centre of the sixth rib on the right side, and over the seventh on the left, at a point halfway between the nipple and the axillary line. The incision must be about four inches in length, and extend down to the bone. Walther has recently, as the result of a series of anatomical studies, recommended the tenth rib posteriorly about a hand's breadth from the spine. While this may be the most favorable point for drainage, it is not to be recommended, because of the rise of the diaphragm subsequent to the operation, which must ascend beyond the level of the aperture and occlude the opening.

We should furthermore remember, as Guerin first taught, that the pleural cavity does not empty itself like a barrel, following the laws of gravity, but, obeying the expansive force of the lung and the crowding of the diaphragm, it causes the liquid to escape in the direction of the least resistance, and therefore toward any opening wherever situated.

After reaching the rib, the soft parts together with the periosteum are reflected from the bone with an elevator; the rib is then denuded of its periosteum posteriorly. If a piece of aseptic gauze is thrust between the bone and the soft parts, the detachment of the latter can be effected with the least difficulty and traumatism by using the gauze as a retractor. About one and a half inches of rib are now removed with two cuts of the bone-nippers or Denison's rib-cutter, which is an excellent instrument for the purpose.[1]

After the removal of the bone all hæmorrhage is checked. "If

[1] Trephining a disk of bone of a rib (Langenbeck, Stone) is a method still frequently resorted to, but is far less satisfactory than the resection of the rib.

the pleura feel tense and bulge into the wound, there is no necessity of making an exploratory puncture. If this is not the case, as a matter of precaution another puncture can be made at this stage of the operation to satisfy the surgeon of the presence of pus underneath. The incision into the pleura is then made with a bistoury in the centre of the periosteal gutter through this membrane and the pleura into the cavity of the chest. This incision must be large enough to allow the insertion of a drainage-tube the size of the little finger. The deep incision of the soft parts can be readily dilated to the requisite extent by the insertion of the finger, which may also be used in interrupting the flow" (Senn).

If a simple pleurotomy is performed, the incision should be made in the very centre of the interspace, following a direction parallel with the ribs. In very thin chests the incision may be made with one plunge of the bistoury, and to be subsequently enlarged with the probe-pointed knife; but this is not safe usually, and the operation should be done preferably in two stages—one incision (about four inches) through the thickness of the skin and subcutaneous tissues, and the other involving the whole thickness of the muscular wall and pleura.

"A great deal of information is gained, as soon as the incision into the chest has been made, in reference to the expansibility of the lung. If this has not been much impaired, the pus will escape with much force, especially during inspiration. Rapid evacuation is attended with some danger from over-distension of the heart and vessels in the lung, and must be guarded against by interrupting the flow from time to time by inserting the index finger into the opening. If the lung expand promptly, its lower margin can often be seen through the opening toward the end of the evacuation. The more the lung expands, the less the amount of air rushing through the opening into the chest. In order to prevent syncope upon the sudden diminution of intrathoracic pressure during the evacuation of the pus, I have been in the habit of administering, before the anæsthetic is given, $\frac{1}{100}$ grain of atropine with $\frac{1}{8}$ grain of morphine, hypodermically, with an alcoholic stimulant by the mouth or rectum.

"If, as is often the case, the pleura is lined with thick, partially detached membranes, these should be removed with a dull curette, as they are invariably infected with pus-microbes, and their presence in the pleural cavity would prolong the infection and retard recovery" (Senn).

Washing out the pleura was formerly an invariable practice after pleurotomy, but a little knowledge of the etiological conditions, as well as the result of unfortunate experience, has taught that this practice has its strict limitations. In all cases in which there is a concomitant bronchial fistula irrigation is necessarily contraindicated. In all cases

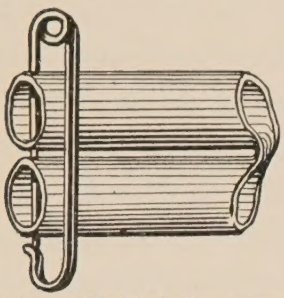
in which there is no fœtor, showing the absence of saprogenic bacteria, it is likewise contraindicated, because it is superfluous if antiseptic precaution and aseptic dressings are used. Furthermore, since Raynaud in 1875 called attention to the accidents that may result from irritation of the pleura by irrigation, apart from the toxic and fatal phenomena that have frequently followed injection with the more powerful antiseptics (sublimate, carbolic acid, and iodoform), we have learned that the greatest circumspection is necessary in the practice. The recent statement by Bowditch[1] that he has only found it necessary to wash out the pleural cavity once in 399 operations upon 250 patients, and that he, who is so experienced an operator, regards it as a serious and dangerous procedure, is in itself quite suggestive. If we add to this the not rare occurrence of the dangerous phenomenon known as pleural epilepsy (Brouardel, Vallin, Boyer, Lepine, Desplats, Weil, DeCerneville), which sometimes terminates fatally, and may end in monoplegia or hemiplegia, we must agree that there is some justification for conservatism in the routine practice of irrigation. Nevertheless, in the putrid or fœtid types of empyæma, or even in those frequent cases in which the dull curette dislodges large pseudo-membranous masses, washing of the pleura becomes a necessity. Then the choice of the proper antiseptics becomes a matter of some consequence. In the more fœtid cases, with heavy, grumous, and fibrinous deposits, it is preferable to remove a little more rib than usual, in order to enlarge the opening and to wash with simple distilled or boiled and filtered water containing about 1 tea-spoonful of common salt to a pint, until the water returns clear. In most cases of this character wiping the pleura with mops of plain sterilized gauze is not superfluous after irrigation. When there is fœtor, the use of Thiersch's solution (2 parts salicylic acid and 12 parts of boric acid in 1000 of sterilized water), Labarraque's solution of chlorinated soda (1 part to 15 or 20 of water), a 10 to 50 per cent. solution of peroxide of hydrogen (Trommsdorf), a thymol solution (Ranke, 1 : 1000 or 1 : 500, added to Thiersch's solution), or the acetate of alumina (Burow), in 1 to 5 per cent. solution, may be freely used without danger of intoxication, care being taken that the solution be always employed warm, as death may follow from the shock of cold irrigation. In addition to this, the irrigation should always be made by using the steady stream of a syphon or fountain syringe, and never by the interrupted flow of a force-pump.

After the pleural contents have been evacuated drainage is in order. For this purpose a resisting, fenestrated, soft-rubber tube, the size of the little finger, should be used. In children one tube is often sufficient, especially if folded upon itself in the manner suggested by

[1] *Annual of the Universal Med. Sciences*, June 2, 1889.

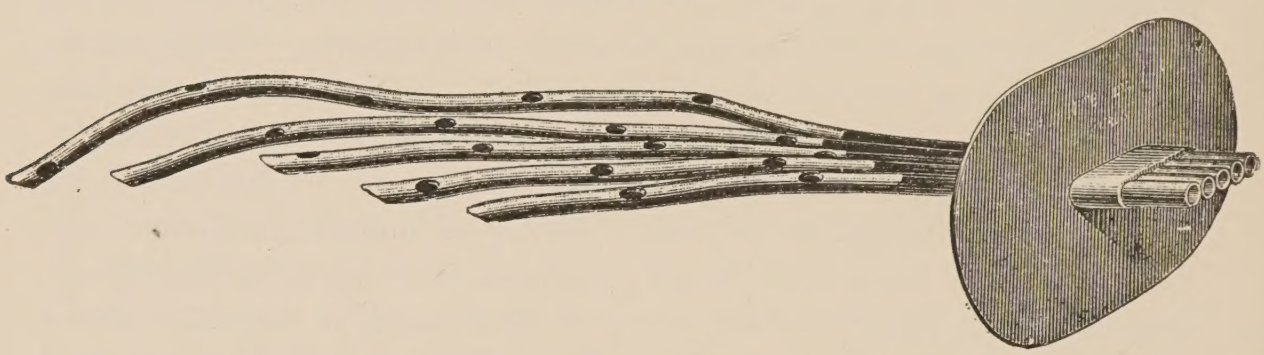
Cabot[1] (Fig. 41). If the case is a recent one, and there are great expansion and mobility of the lung, it is only necessary for the tubes to be of sufficient length to project a short distance within the cavity; long tubes in these cases irritate unnecessarily. If, on the other hand, the lung is bound down by adhesions, and does not approach the opening, leaving a considerable cavity, then a set of long tubes which will reach the deepest pockets and recesses of the cavity may be used with advantage. The arrangement of the tubes in the manner suggested by Dujardin-Beaumetz (*en flute de Pan*) is probably the best, though the advantages of the grouping of the tubes may be obtained by more simple means, and the shield shown in the cut (Fig. 42) dispensed with.

Fig. 41.



Cabot's Folded Drainage-tube for Empyæma in Children.

Fig. 42.

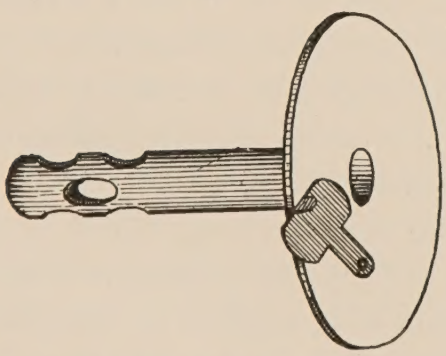


Arrangement of Drainage-tubes *en flute de Pan* (Dujardin-Beaumetz).

A safety pin may be conveniently substituted for the shield.

A simple long safety or beaded pin will do as well if it is made to transfix the required number of tubes; if a beaded pin is used, the pointed end should be protected with a rubber or small cork tip. By the use of these precautions the tube will be prevented from slipping into the cavity, and thus giving rise to an ugly accident.

Fig. 43.



C. Denison's Soft-Rubber Valvular Tube.

Useful in later stages of thoracic fistula after empyæma when there is diminished suppuration and it is necessary to help the compressed lung to expand.

Later on, as the suppuration is reduced to a minimum and the opening contracts, it may be advantageous to use (especially in chronic cases with atelectasic and bound-down lungs) the valvular drainage-tube recently recommended by Denison of Denver (see Fig. 43).[2] In this instrument the tube, which is made of soft rubber, is closed externally by a movable, very delicate, thin platinum valve, which can be

[1] Keating's *Cyclopædia of Diseases of Children*, 1889. [2] *Sanitarian*, Nov., 1890.

swung to one side for the purpose of injecting the cavity or cleaning the tube. "This valve is intended thoroughly to close the opening against the entrance of air, yet be so flexible that the increased intrathoracic pressure due to cough or forcible respiration will force out the contained air or fluid. The result is, that the air is all the time being pumped into the atelectatic lung through the exaggerated mechanism of breathing. It is intended that the patient of his own motion can, by straining to increase intrathoracic pressure, force the air or pus out of the tube, but by no effort of his own breathing can he draw air back through the tube into the pleural cavity. In this way the first expansion of the lung may be hastened and the cavity obliterated. But a good aseptic occlusive dressing, such as the one here recommended, when well applied will answer with ordinary drainage-tubes all the purposes of this tube."

In dressing the wound the following method is usually adopted by the author: First, about half a yard of iodoform gauze (10 per cent.) is loosely packed around and over the tubes. Over this about one inch thickness of bichloride gauze (1 : 2000, Laplace's formula) or the plain sterilized gauze is made to cover the iodoform layer for a large area over the wound, and over this, again, a heavy pad of bichloride or carbolated cotton (three or four inches thick) is applied to provide for equal pressure. Finally, the whole dressing is held together by a breast-bandage, supported by an elastic, loosely-woven bandage (manufactured by Messrs. Johnson & Johnson and Seabury & Johnson) which is excellently adapted for this class of operations.

A dressing thus applied need not be renewed for twenty-four hours in ordinary recent cases. We cannot too much insist upon the absolute necessity of the greatest caution in renewing the dressings. Unfortunately, too many nurses, students, and physicians are under the impression that the first dressing is the only one that requires scrupulous care as to the aseptic precautions; they imagine that because there is pus in the dressings the antisepsis is a failure, and that further precautions are unnecessary. No more serious blunder could be entertained, and its commission means a fundamental misconception of the principles of asepsis. In the case of an ordinary empyæma our external dressing and careful antiseptic precautions cannot immediately affect the pyogenic and pathogenic micro-organisms that are contained in the purulent pouch, but they do prevent the introduction of saprogenic or septic organisms which will transform a simple *pus* cavity into a *septic* cavity. For this reason it is impossible to urge too emphatically the necessity for the utmost vigilance on the part of the dresser of the wound, for any neglect on his part to be aseptically clean may most seriously compromise the life of the patient. This vigilance should not relax until the closure of the wound in acute cases, nor in

the chronic cases until the secretion of pus is so scant that there can be little, if any, danger from decomposition. Should the pus be originally septic or become so at any time, as manifested both by the temperature and fœtor, then aseptic occlusion must give way to frequent antiseptic irrigations, as previously described. In these cases the first aim of antiseptic surgery—*i. e.* aseptic union by primary adhesion of the opposed pleural surfaces—can no longer be entertained, as healing can only take place by granulation and protracted suppuration. In these cases also irrigation of the pleura with hot Thiersch's solution by means of a syphon, on the principle of the Potain apparatus, may be required for hours at a time. Usually, however, the radical operation, when performed with scrupulous regard to asepsis, is very satisfactory in all cases in which the pleura is opened before permanent adhesion and crippling of the lung has taken place.

In the most favorable conditions complete recovery, including the closure of the thoracic wound, has been observed in ten to twenty days (Schede); Hack obtained an average cure in twenty-three days; Moutard-Martin, in twenty-three to twenty-eight days; but the nearest approach to general results are given by Peyrot and Robert, who estimate that the average duration of the treatment is four months in adults and two months in children (Widal).[1] Nevertheless, there are many cases, unfortunately too many, in which, owing to the protracted postponement of operative interference, the lung has remained permanently bound down by adhesions, and the resisting chest-wall has not been able to sink in sufficiently to permit the pleural surfaces to come in apposition; in these cases the external wound is liable to remain open, and a thoracic fistula, communicating with the pleura, constantly discharging pus, will remain.

The only hope of remedying this unfortunate condition lies in 6 the *multiple resection of the ribs* of the affected side, to prevent the chest-

[1] Professor Küster of Berlin, whose wise motto is never to allow an empyæma to grow old, performs pleurotomy in a different way from that described in the text. His method consists in making an incision into the fourth interspace anteriorly through which is passed a long probe (a long uterine probe will do), by which he explores the interior of the empyæmatous cavity, and by this means determines the precise location of the most dependent portion behind, where he resects one or more ribs freely enough to permit him to obtain an easy view of the interior of the cavity. He then irrigates with salicylic solution and mops over the interior with a sponge. He has operated on 109 cases, the largest statistics thus far presented. His cases include some old cases of bronchial and thoracic fistula. His results are as follows: complete cure in 60, or 52.04 per cent., not cured, 17, or 15.59 per cent., died, 33, or 29.35 per cent. of the total cases. Only 6 deaths were directly due to the operation. Küster furthermore maintains that every case of empyæma is an indication for operation, even when occurring in markedly tuberculous patients. While we believe that Küster's operation is an excellent one for the chronic cases, still, with Schede and others, we also believe that the anterior puncture is superfluous in the acute or recent cases. (*Trans. Tenth Int. Med. Congress*, 1890; *Rev. de Chirurgie*, 1890.)

wall from sinking in and obliterating the pus-forming cavity. This operation, which was first practised by Symonds in 1869, Letievant in 1875, but systematized and popularized by Estländer of Helsingfors, by whose name it is now universally known, has its strict limitations. The operation of Estländer may be considered as absolutely contraindicated—1st, in advanced age; 2d, in cases of pleurisy associated with marked tubercular or other lung lesions; 3d, in albuminuric or other cachectic subjects; 4th, in very large cavities, with completely and permanently collapsed atrophied lung; 5th, in comparatively small cavities if these are limited to the extreme upper segments of the thorax. On the other hand, as Berger's statistics show, the longer the fistula remains open after pleurotomy, the less easy is it to cure; for this reason, and provided there are no other contraindications, the advantages should be seriously considered early. If the fistula shows no sign of healing three or four months after operation, and the retraction of the chest appears to be arrested, it is best not to delay operative interference.

The operation is usually performed by making several transverse (horizontal) incisions in the interspaces parallel with the ribs, as originally recommended by Estländer, or by making an H-shaped incision (Trelat) or an inverted ⊥ (Nicaise). These incisions are made in the lateral aspect of the thorax, preferably the subaxillary region. By dissecting and retracting the skin-flaps that result from these incisions the ribs are readily exposed, and sections of each, varying from three to six centimeters, are removed. The resection of the ribs is effected separately and subperiosteally, though Olliver has taught that in children the growth of bone from the periosteum is so rapid that it is best to remove the periosteum as well as the bone.

The number of ribs to be removed and the size of each section must depend upon many circumstances, especially the size of the cavity. As a rule, the first and tenth ribs, which support the sternum, should be respected. After the excision of the ribs and completion of the hæmostasis the cutaneous flaps are brought together by suture, due provision being made for drainage.

In the original Estländer's operation the pleural cavity itself is not opened, the costal resection being effected subperiosteally. In many cases, however, it is preferable to lay the cavity freely open as well, and subject it to a systematic curetting in order to remove degenerate foci, and to pack it with sterilized or weak iodoform gauze; in other words, to subject the chronically diseased pleura to the same principles of treatment that are applied to other suppurating cavities.

Not only is curetting done, but the excision of the thickened parietal pleura as well, is now being practised with success. Schede of

Hamburg, who believes that Estländer's operation is totally incapable of securing the necessary collapse of the chest-wall in adults, resorts to a complete *thoracoplasty*, by which all the soft parts, with the pleura and ribs, are removed from the side of the chest, leaving only a skin-flap to cover over the enormous visceral wound.

At the Tenth International Congress at Berlin (1890) Schede reported 11 cases in which he had resorted to this truly heroic operation, of which he lost only 3—1 dying of iodoform-poisoning, another by collapse, and a third of exhausting suppuration. Other surgeons—Bouilly, Thiriar, Boeckel, Rugi—while not dealing with the subject on so large a scale, have also had excellent results from this free and open treatment of the pleura.

One word, finally, before dismissing the surgical treatment of empyæma, and that is in reference to interference in the tubercular cases.

While many writers teach, with Senator and others, that the existence of tubercle contraindicates the radical operation, we believe that the whole question depends upon the degree of tuberculosis and cachexia affecting the patients.

To operate should be the rule in all cases associated with slight tubercular lung-lesions and a good general condition. In many cases the pulmonary lesions appear to be arrested by the removal of the pleural exudation.[1]

On the other hand, it is imperative to abstain in the advanced cases in which one or both lungs are seriously involved and the patient is succumbing to hectic. To operate under these circumstances, except by simple palliative aspiration, would of course merely promote euthanasia.

Medical Treatment.—Finally, it is hardly necessary to insist upon the medicinal, dietetic, and general hygienic support that patients who have been operated on for empyæma should receive. In few morbid conditions is there so marked general physical deterioration, owing to the hectic and protracted suppuration. The drain on the corpuscular elements of the blood is enormous, as is soon revealed by the waxy pallor and progressive emaciation of even the acute cases. Throughout the whole surgical treatment the patient should be carefully supported by the frequent administration of stimulants—whiskey, brandy, or rum—in the shape of toddy and milk-punch. A plain but very substantial diet should be insisted on. Free ventilation and plenty of sunshine are great aids to recovery. The cough which accompanies these cases is frequently very harassing, and demands medicinal assistance. The preparations of opium are the only drugs which afford relief. They should, however, be administered with caution, and only

[1] *Vide* cases reported by Bricheteau, Aran, Hayem, Widal.

when the cough or other indication necessitates their use. The following formulæ will be found useful:

℞. Morphinæ sulphatis, gr. ij;
Aquæ lauro-cerasi, f℥ss;
Syrup. tolutani, q. s. ad f℥ij.—M.
Sig. A tea-spoonful when needed.

Also, if there is considerable circulatory depression, shown by weak pulse and cold extremities, with irritating cough:

℞. Syrup. morphinæ (gr. j–℥j), f℥j;
Spiritus ammon. arom.,
Spiritus ætheris comp.,
Tinct. digitalis, āā. f℥ij;
Syrup tolutani, f℥j;
Aquæ menthæ piperit., ad f℥vj.—M.
Sig. One table-spoonful every two or three hours.

In cases in which the stomach is very irritable hypodermic injections of $\frac{1}{8}$ or $\frac{1}{4}$ grain of sulphate of morphine should be given, or the following may be used:

℞. Cocainæ hydrochlor., gr. ss;
Sodii bicarb., ℥ss;
Aquæ lauro-ceras., f℥ij;
Syrup. morphinæ (gr. j–℥j), f℥ss;
Aquæ menth. piperit., q. s. ad f℥iv.—M.
Sig. One table-spoonful every hour.

This will generally control not only the cough, but the accompanying dyspnœa and vomiting.

In the septic cases with hectic sweats the addition or separate injection of $\frac{1}{150}$ grain of atropine is of advantage. For the fever of these septic cases sulphate of quinine is indicated in large and frequent doses. The antipyretics are contraindicated in these cases, and should not be used when the febrile movement is not alarming in itself. Quinine, in fact, should be administered for its tonic effect throughout the whole of the treatment, from the moment pus is recognized in the pleura to the end of convalescence. Instead of the antipyretics, frequent cold sponging with water, bay rum, or the *eau sédative* (Raspail) of the French Codex is most soothing and beneficial. In the diarrhœa that so frequently accompanies the septic cases either the pilula plumbi cum opii or the following mixture will be found useful:

℞. Bismuthi salicylatis,
Bismuthi subnitratis, āā. ʒij;
Vini opii, fʒj to ʒij;
Aquæ lauro-ceras., fʒj;
Tinct. catechu. comp.,
Tinct. kino, āā. fʒiij;
Olei sassafras, ♏xvj;
Mucilag. acaciæ,
Syr. menth. piperit., āā. q. s. ad fʒvj.—M.

Sig. One table-spoonful every two or three hours, according to the amount of diarrhœa.

If the discharges are fœtid, the addition of 10 grains of salol every two hours in tablets or capsules will act as a corrective.

When convalescence is established, quinine, combined with strychnine, iron, and arsenic, is the best hæmatic tonic. In the tubercular cases the addition of the hypophosphites is especially serviceable.

Thus in non-tubercular cases:

℞. Strychninæ sulphatis, gr. j;
Liquor. potassii arsenitis, fʒij;
Ferri et quininæ citrat., ʒiv;
Glycerini,
Aquæ cinnamomi, āā. ad fʒviij.—M.

Sig. One tea-spoonful after meals, followed by half an ounce of whiskey diluted in toddy.

When the palate is too sensitive, the same remedy may be given in pill form:

℞. Strychninæ sulphatis, gr. j;
Sodii arsenitis, gr. j;
Quininæ sulphatis, ʒj;
Mass. ferri carbonat., ʒj.—M.
Ft. in capsul. No. xxx.

Sig. One capsule three times daily after meals.

In the tubercular cases:

℞. Liq. potassii arsenitis, fʒj;
Syrup. ferri iodidi, fʒiij;
Elixir. calisayæ (National Formulary), fʒviij.—M.

Sig. One table-spoonful three times daily.

The compound syrup of the hypophosphite of soda, lime, strychnine, manganese, etc., and especially cod-liver oil with guaiacol (cod-

liver oil, 1 pint; guaiacol, 2 drachms), and inhalations of oxygen, are very helpful.

Furthermore, the patient should be urged, as soon as his strength will permit, to walk out-doors, to exercise his lungs by systematic pulmonary calisthenics and by mountain-climbing or other suitable exercise, as indicated in the section on the After-Treatment of Non-purulent Pleurisy.

PYOTHORAX.

While the word "pyothorax" is frequently used synonymously with empyæma, there is nevertheless a difference in the application of the two words. By pyothorax is meant an accumulation of pus in the pleura of non-pleuritic origin. The word simply involves an etiological distinction; in the light of the therapeutic indications the two conditions are practically identical.

HYDROTHORAX.

By this term is meant a secondary non-inflammatory dropsy of the pleura, usually involving both sacs. It is most frequently dependent upon conditions involving marked intravenous tension, combined with hydræmic states of the blood; for this reason it is most frequent in the latter stages of valvular heart disease and in chronic nephritic inflammations. The treatment is entirely subordinate to that of the general condition which gives rise to the dropsy. As there are no plastic exudations or neo-membranous formations to interfere with the absorbent functions of the pleura, marked beneficial effects may always be expected from the exhibition of those agents which will diminish intravenous tension and will tend to fill the arterial tree (digitalis, strophanthus, convallaria, caffeine citrate, strychnine); derivative medication will also produce much more marked results than in the case of the exudations due to pleurisy. Epsom salt in concentrated solution (Matthew Hay's method); elaterium ($\frac{1}{4}$ to $\frac{1}{2}$ grain), modified by hyoscyamus; compound jalap powder, gamboge, and scammony, are valuable intestinal derivatives. Of the diuretic class, for all cases, diuretin is prominent, and when the cause of the dropsy resides in the heart the free exhibition of sugar of milk (1 to 2 ounces daily), combined with the cardiac tonics, as recommended by Germain Sée, is likely to give rise to surprising results. Of the diaphoretics, the pilocarpine, administered hypodermically, is still *facile princeps*.

When the fluid accumulates very rapidly, and the signs and symptoms of pulmonary compression become threatening, aspiration, practised in accordance with the rules laid down in the section on thoracentesis, will be the most certain means of affording relief. The limpidity of the fluid and the absence of floating exudative coagula will permit of the removal of the fluid with the smallest needle or trocar of the aspirator, thus ensuring the least pain and freedom from the petty annoyances incident to the obstruction of the canula.

HÆMOTHORAX.

An accumulation of blood, of non-inflammatory origin, in either one or both pleural cavities, is called hæmothorax. The hæmorrhage may be due to traumatic or pathological causes. Stab, punctured, and gunshot wounds are the most frequent causes of the traumatic variety. In these cases the hæmorrhage is frequently complicated with pneumothorax. The hæmorrhage proceeds either from a visceral or parietal vessel; in the latter case the internal mammary and intercostals are most frequently implicated. In the visceral wounds the danger of hæmorrhage increases from the periphery to the root of the lung, wounds of the pulmonary trunks, azygos, and vena cava causing almost immediate death from vascular depletion, syncope, and shock. Of the pathological causes, aneurism of the aorta or its thoracic branches, ulcerations of the internal mammary and intercostal arteries from carious ribs (peripleuritic abscesses), from varicose veins of the pleural surface (Caldani), or from the rupture of a bleeding tuberculous vomica into the pleura (Fräntzel), are the most prominent causes.

It is manifest that the therapeutic indications will be profoundly influenced by the cause of the hæmothorax. There are, nevertheless, a few general and fundamental principles which dominate the therapeutic indications, and which exercise a practical influence on our mode of treatment.

In all pleural hæmorrhages an attempt should be made to differentiate the cases in which infection is, *ex necessitate*, an accompaniment of the hæmorrhage from those in which it is not. In gunshot and punctured wounds, for instance, if the external wound is sealed promptly, infection is not probable, since the wound is usually, primarily, aseptic; and if the hæmorrhage is not progressive the patient will suffer only from the shock, the anæmia, and the mechanical displacement produced by the hæmorrhage, but not from a secondary puru-

lent or septic pleuritis due to infection. It is also a fortunate circumstance that many of the pathological conditions which cause hæmorrhage are not always pyogenic *ab initio*, though infection is here more common than in the traumatic cases.

Again, as shown by the experiments of Bouley, Trousseau, and LeBlanc, the blood extravasated into the pleura is capable of rapid spontaneous absorption, provided it be not contaminated with pyogenic or saprogenic micro-organisms. In this respect the pleura shows a characteristic common to all serous membranes. The pleura, however, displays this capacity for blood-absorption in a degree inferior to the peritoneum, which so greedily absorbs blood that in acute traumatic anæmia its absorbent powers have led to the practice of "intraperitoneal transfusion" (Ponfick and others). This capacity for unaided absorption on the part of serous membranes should be remembered in connection with hæmothorax, and should moderate the over-anxiety of the practitioner who, without due consideration of the resources of Nature, would attempt to remove the effused blood simply for the fear of its presence.

Apart from these general considerations, the therapeutics of hæmothorax are largely governed by the same principles which underlie the treatment of hæmorrhage elsewhere. The means at our command may therefore be divided into medical and surgical.

Medical.—Rest is, above all, indicated, and is best secured by the horizontal decubitus and exhibition of opium or morphine in quantities sufficient to obtund pain and diminish the frequency of the respiratory movements. It is preferably administered in the shape of morphine sulphate ($\frac{1}{4}$–$\frac{1}{2}$ grain) hypodermically. Cold to the chest by means of the ice-bag, aided by the internal administration of fluid extract of ergot ($\frac{1}{2}$ to 1 drachm) every hour while hæmorrhage is progressing; ergotine (Bonjean's, Merck's, Parke Davis & Co.'s) hypodermically (1 to 5 grains); hydrastine muriate or sulphate by the mouth ($\frac{1}{2}$–1 grain); hydrastinine (Parke Davis & Co.'s); fluid extract of hamamelis (1 to 2 drachms); acetate of lead in pill (5 grains); capsules or pearls of spirits of turpentine, muriated tincture of iron, sulphuric-acid lemonade, etc., are especially indicated in the treatment of visceral or parenchymatous bleeding.

Surgical.—When the hæmorrhage is of traumatic origin and due to the lesion of a parietal vessel, an attempt should be made to secure the bleeding point, especially if the internal mammary or the intercostal vessels be involved. In some cases in which life is nearly extinguished in consequence of vascular depletion time may be gained by sustaining the circulation with saline solution (1 drachm of common salt to 1 pint of water) injected intravenously until the pulse is restored to normal fulness. By this means the patient may be restored

sufficiently to permit the hæmorrhage to be permanently arrested by either ligating or obturating the bleeding point. Whether the bleeding point be discovered or not, it is best to occlude the wound immediately by antiseptic dressings, such as iodoform gauze, collodion, cotton, etc., and to await the development of further indications. If the increasing dyspnœa, intercostal bulging, and physical signs point to a progressive hæmorrhage with compression of the lung, which is rapidly increasing in spite of morphine and the ice-bag, then intercostal pleurotomy under strict antiseptic precautions is the only means of securing relief. Cautious aspirations may be tried, but, owing to the rapid formation of clots, it is often impossible to relieve the compressed lung by this method; nevertheless, a preliminary attempt at partial evacuation by this means is justifiable, and is worthy of trial, though it is more than probable that the rapid reaccumulation of blood will necessitate the subsequent free incision of the pleura. Larrey, who was probably the first to practise this operation in traumatic cases, always advised that only the least quantity of blood required to secure relief should be removed by the thoracic incision, in order not to disturb the primary hæmostatic thrombus. By rigorous adherence to antiseptic methods it is possible to perform pleurotomy in these cases with great prospect of preventing the final decomposition of the remaining clots. If suppuration should supervene, we should be guided in the treatment by the rules that have been laid down in dealing with empyæma.

PNEUMOTHORAX.

Hydro- and Pyo-pneumothorax.

The collection of any kind of gas in the pleural sac is called pneumothorax; if serum or other watery fluid is added to the gas, the condition is designated hydro-pneumothorax; if blood, hæmo-pneumothorax; if pus, pyo-pneumothorax; if both blood and pus, pneumo-pyo-hæmothorax, etc.

The essential primary pneumothorax of the older authors, which was supposed to be due to the spontaneous development of gases in the pleura (Itard, Laennec), is no longer admitted; even the existence of secondary pneumothorax resulting from the decomposition of putrid purulent secretions (Jaccoud, Biermer, Wunderlich, Rosenthal, etc.) is only an exceptional, and even doubtful, occurrence. Our present knowledge of the pathology of pneumothorax reduces its etiology to either traumatic or non-traumatic causes, which, residing in the lung, pleura, or adjoining organs, lead to a perforation in the parietal or vis-

ceral layers, and thus to the admission of external air into the pleural space. The perforations due to stab and gunshot wounds and to lacerations by fractured ribs, contusion, and other results of external violence appertain to the domain of surgery. There is another form of traumatism, however, which especially interests the physician. We refer to those cases of simple pneumothorax which develop as a result of the laceration of the pulmonary parenchyma from violent inspiratory efforts or other conditions which suddenly increase the intrapulmonary tension. This condition has been undoubtedly observed in persons with apparently healthy lungs, and is a consequence of violent and sustained inspiratory efforts accompanying muscular strain, as in lifting heavy weights, in the expulsive efforts of parturition, etc. In the vast majority of the cases, however, an antecedent pathological condition in the lung which favors its laceration under increased pressure precedes the tear that leads to pneumothorax. In the cases in which the rupture takes place in a healthy lung the entrance of air is never followed by any other than the immediate consequences of the mechanical displacement produced by the sudden or gradual distension of the pleura. In the pathological cases, in which the admission of air is concomitant with the entrance of irritants or septic matter, the pneumothorax is promptly followed by the superadded symptoms of pleuritic inflammation, which ends in either serous, purulent, putrid, or gangrenous accumulations, according to the greater or less degree of virulence of the matter inoculated at the time of the rupture in the lung. Practically speaking, in the immense majority (90 per cent.) of the non-traumatic cases, as shown by the accumulated statistics of Saussier, Biach, Weil, Hughes, and West, the cause of pneumothorax is tubercular degeneration of the lung.

Of the other causes, empyæma (rupturing into a bronchus), gangrene of the lungs, bronchiectasis, pulmonary abscess, hæmorrhagic infarcts, pulmonary hydatids, abscess of the liver, emphysema, asthma, capillary bronchitis, and pertussis occupy a secondary but easily explained relationship with the causation.

Usually, pneumothorax is unilateral, though both pleuræ may be rarely involved. Owing to the greater frequency of tuberculosis in the left lung, left pneumothorax is the more common. It may also be complete or partial, according to whether the air enters the whole pleural space or only a small encysted locus.

At any rate, no matter what the particular cause of the perforation may be, we may conveniently group all the conditions into three types of pneumothorax (Weil)—viz.: (1) the open, (2) closed, and (3) the valvular pneumothorax. In the first the point of perforation remains open, so that the air on respiration passes in and out of the pleural cavity; for example, in stab wounds, empyæma after pleurotomy, and

the rupture of an empyæma into a bronchus. In the second variety the opening leading to the pleura becomes closed, and the air in the pleural cavity remains stationary, or, at least, is not perceptibly increased or decreased by respiration. This condition may result from either cicatricial, adhesive, exudative, or other mechanical conditions which favor the occlusion of the orifice, and consequently may be observed in many conditions. In the third variety—valvular pneumothorax—the orifice is opened during inspiration and closed during expiration. Under these circumstances it is easy to conceive that the most distressing symptoms are likely to follow, since the intrapleural tension progressively increases through the constant addition of air, and finds no relief in an expiratory escape.

The symptoms that follow the admission of air into the pleura depend mainly upon the rapidity with which it takes place, upon the causes that give it birth, and upon the condition of the patient at the time of its occurrence. The mechanical effects of a sudden reduction of the respiratory area produced by the compression of the lung immediately give rise to symptoms that call most urgently for relief, and if the patient survives the primary shock and succeeds in accommodating himself to his reduced respiratory capacity, we subsequently observe that to the primary symptoms are added those of the pleuritic inflammatory disturbances with serous, purulent, or hæmorrhagic exudations that follow the inoculation of the pleura with pyogenic or saprogenic bacteria.

As the condition presents itself suddenly in the vast majority of cases—*i. e.* in consumptives—the principal symptoms of pneumothorax are sudden acute pains in the side, attended with great dyspnœa and shock. The countenance is anxious, distressed, and cyanotic, especially as the dyspnœa increases to orthopnœa. There is sometimes collapse, especially when a large vomica bursts in the last stage of phthisis. The pulse becomes frequent (140), feeble, and small, the respirations relatively more frequent than the pulse, and the voice feeble or suppressed. There is occasionally great hyperæsthesia of the affected side. The temperature sinks below normal. The patient either lies upon the affected side to allow the healthy lung to expand with more freedom, or sits up with the elbows or hands resting upon his knees. The patient is sometimes conscious of something giving way. All the symptoms of pneumothorax may be most closely simulated in an attack of acute pulmonary congestion supervening upon already advanced disease (Powell). On the other hand, there may be almost an entire absence of any special symptoms to mark the onset of the attack. The physical signs, however, decide the diagnosis; there is marked barrel-like bulging of the affected side; the heart, diaphragm, and liver are notably displaced, according to the side which

is affected. Percussion at once elicits a characteristic hyper-resonant (tympanitic) note; the respiratory murmur is absent or very feeble; amphoric breathing may be heard, accompanied by metallic tinkling. Auscultatory percussion reveals ringing, clanging noises (*bruit d'airain*), etc. When the pneumothorax is complicated with purulent or other effusions the Hippocratic splashing sounds, together with the other physical signs characteristic of these exudations, are added to those which are especially diagnostic of the presence of air in the pleura.

From the preceding synoptical sketch of the etiology, pathology, and symptomatology of pneumothorax we may classify the therapeutic indications of this complex condition into the curative and symptomatic. Before proceeding to the discussion of these indications, it is very important that we should lay down a fundamental pathological distinction which must exercise a profound influence upon our therapeutics. As has already been stated, there are cases in which pneumothorax develops in persons apparently healthy: this occurs usually at the most vigorous period of life (seventeen to thirty-seven years, Gaillard), when, as the result of a violent effort, the pulmonary vesicles give way and the air is admitted into the pleura. The pleura is in these cases healthy and the physical signs are strictly those of pneumothorax. Nothing but air, and possibly a little blood, are admitted into the pleura from the ruptured lung; furthermore, the air admitted, being filtered by its passage in the lesser air-passages, is *germless*. The conclusion from this is that no inflammatory reaction, no pleurisy, follows the entrance of the germless air into the pleura, and consequently no apprehension need be entertained from the accident, excepting on the score of the purely physiological effects of the mechanical displacement of the lung, which may, of course, be very serious, especially if both pleuræ are involved, as in a recent case (a parturient woman) reported by Otto Lazius. The benign course generally followed by these cases, which rarely call for therapeutic intervention after the acute symptoms are relieved, is well attested by the experience of Havilland, Hall, Rix, Del Grange, Biermer, Ricker, Fräntzel, W. Zahn, Gaillard, and others.

The acute symptoms which develop with the sudden occurrence of pneumothorax are due to shock, asphyxia, syncope, and exhaustion. The shock is due to the sudden lesion of a vital and most sensitive organ; the asphyxia, to the sudden suppression of a large part of the respiratory surface, especially in those subjects who (90 per cent. of the cases) are already lung-crippled. The syncopal symptoms are due to the overcrowding of the right heart and venous trunks with the blood that has been squeezed out of the collapsed lung; finally, the prostration is a natural consequence of the pain and intense dyspnœa which is superadded to an already exhausted subject. All these com-

bined indications are best met by the hypodermic injection of $\frac{1}{4}$ or $\frac{1}{2}$ of a grain of morphine and $\frac{1}{150}$ of atropine if the patient is an adult, or a proportionate dose if a child. This relieves the shock, the pain, and the dyspnœa; to this should be added liberal inhalations of oxygen to diminish the tendency to asphyxia, and the internal administration of the general and respiratory and cardiac stimulants, preferably ammonia, ether, camphor, strychnine, digitalis, strophanthus, caffeine citrate, etc. The mistura chloroformi et opii of the National Formulary,[1] or the elix. chloroformi comp. (one tea-spoonful equals 1 grain of opium and 2 minims of chloroform), or the original chlorodyne (Collis Browne's), are excellent preparations when the hypodermic syringe is not at hand, or when a stimulant sedative is to be kept up after the first hypodermic injection of morphine. A formula which would also meet the indications, and which has been frequently prescribed by the author, is the following:

℞. Tinct. moschi, fʒj;
Spts. ammoniæ aromat., fʒij;
Spts. ætheris comp., fʒiij;
Tinct. digitalis, fʒj;
Elixir aromat., q. s. ad. fʒij.—M.
Sig. One tea-spoonful every hour until relieved.

Another convenient formula for the same essential ingredients is:

℞. Tinct. moschi,
Tinct. camphor.,
Spts. ammon. aromat.,
Spts. ætheris comp.,
Tinct. capsici,
Tinct. digitalis, āā fʒij.—M.
Sig. Sixty drops in one ounce of strong toddy.

Sulphate of strychnine ($\frac{1}{50}$ grain) every hour for two or three doses, or caffeine (1 to 5 grains) should be administered hypodermically when evidences of heart failure are dominant. In addition whiskey, brandy, or other stronger alcoholic is in order.

Usually, also, the use of stimulating embrocations to the skin, such as mustard plasters to the back, dry cups, bags of hot water, or a stimulating liniment, such as the linimentum ammoniæ or tincture of mustard with soap liniment, help considerably to relieve the immediate distress by cutaneous derivation.

[1] Each fluidrachm of which contains $7\frac{1}{2}$ minims of chloroform, $7\frac{1}{2}$ minims of tinct. cannabis. ind., $3\frac{1}{4}$ minims of tinct. capsicum, 1 minim of fluid ext. of belladonna, and about 1 gr. of opium.

In some cases the preceding measures afford only temporary relief; the dyspnœa, with marked cyanosis and feeble rapid pulse, continues to be a menace from asphyxia. The increasing barrel-like fulness of the chest and physical exploration explain the condition, which is manifestly due to increasing and unrelieved intrathoracic pressure. The only logical treatment is then to give a free exit to the pent-up air, and thus liberate the lung. Thoracentesis is in such a case the only means of securing relief. The method of performing it is of course a matter of some moment.

The operator must avoid three things: (1) The readmission of air; (2) the contamination of the contained air, especially if this has gained admission into the pleura through a healthy pulmonary parenchyma, as in traumatic cases; (3) the excessive reduction of the intrapleural tension beyond the point of giving simple relief, for fear that by allowing the lung to expand the original perforation will be enlarged and its healing interfered with.

Probably the best way of securing the desired result is by the use of the aspirator. An ordinary small or capillary trocar will do in the very urgent cases, especially if a piece of gold-beater's skin is stretched over the orifice to prevent the readmission of air. When relief is obtained the trocar can be removed, and the opening in the chest sealed with cotton saturated with iodoform collodion or with adhesive plaster. Care should be taken to do this thoroughly, otherwise a general subcutaneous emphysema may supervene which will give rise to serious trouble.

We have thus far considered the purely symptomatic or palliative treatment; now a few words as to *curative* measures that may be entertained for the permanent relief of the more favorable cases.

While the permanent cure of pneumothorax may be obtained in many cases, even of the worst type, the ultimate result will depend upon the nature of the cause that immediately led to the pneumothorax; and as this condition is almost always tuberculosis in the non-traumatic cases, we can readily understand the gravity of the final prognosis. In a general way, it may be stated that the final removal of the air from the thorax can be effected only by operative means, and these reduce themselves to thoracentesis with aspiration or pleurotomy.

In the open type of pneumothorax—*i. e.* that variety in which the intrapleural pressure oscillates with the inspiratory and expiratory movement—it is self-evident that thoracentesis cannot affect the condition except in those cases which are associated with either a serous, purulent, or putrid accumulation in the chest, as in those cases of empyæma or other form of pyothorax which burst by a large opening into a bronchus. Under these circumstances aspiration—or, better,

if the condition of the patient warrant it, a free incision into the pleura with or without resection of a rib, as in the manner previously described (*vide* Empyæma)—is the surest way of giving permanent relief. If it is a large tubercular vomica that has perforated into the pleura, death usually overtakes the patient before any such mode of relief can be contemplated, and palliation alone can be recommended.

In *closed* pneumothorax—*i. e.* in which the opening that has admitted air into the pleura is closed, and the existing pneumothorax is not reinforced by inspiratory efforts—surgical interference is most fortunate in its results. In the *aseptic* pneumothorax from strain, already referred to, the absorption of air takes place spontaneously; and in those cases in which the accumulation is followed by pleurisy with serous effusion (hydro-pneumothorax) or with pus-formation (pyo-pneumothorax) aspiration, followed, if the patient's strength allows it, by pleurotomy, is the best mode of relief.

In *valvular* pneumothorax (*a soupape*), which occurs almost exclusively in phthisical cases, and in which the greatest distress is caused by the continued increase of intrapleural tension from the constant additions brought in by inspiration, the operative indications will vary with the stage of tuberculosis in which the accident has taken place. In the advanced cases the immediate danger of asphyxia may be averted by aspiration or tapping if opiates fail. In the earlier and stronger cases aspiration may be resorted to with the greatest hope of success, not only as regards the cure of the pneumothorax, but improvement of the phthisical process. Here surgical interference must be resorted to with the greatest discretion. If aspiration is performed too early, great harm may be done by favoring the premature expansion of the lung and the consequent reopening of the pulmonary fistula which led to the original pneumothorax. On the other hand, if evacuation of the pleura is too long delayed, permanent and irreparable collapse of the lung may take place. The use of the manometer in conjunction with the aspirator is of great service, by informing the operator of the exact degree of intrapleural tension during the operation.

The following conclusions, from a recent and careful paper by Potain (*Gaz. des Hôpitaux*, April 26, 1889), may be regarded as a very modern and authoritative presentation of the indications for interference in pneumothorax. He says: "1. In the beginning, when pneumothorax does not give rise to marked dyspnœa, no surgical interference is indicated. 2. When by a valvular mechanism at the seat of the perforation the air accumulates in the thorax at a dangerous tension, which can be recognized by distension, by the displacement of the diaphragm and mediastinum, it is necessary to evacuate by puncture enough air to ren-

der the pressure within equal to that of the external atmosphere. 3. If a sero-fibrinous effusion occurs, abstain from interference as long as it is not dangerous from its weight or volume. 4. When the effusion passes this limit the fluid must be entirely withdrawn, in such a manner that the intrapleural pressure constantly equals the normal atmospheric pressure—seven millimetres of mercury. 5. If the effusion is sero-purulent, and not fœtid, the same rule holds good. 6. But if the seat of the purulent accumulation communicates with a bronchus, or if the effusion is purulent and fœtid from the beginning, it is necessary at once to operate as for empyæma if the opposite lung will be sufficient for the respiratory needs of the individual, notwithstanding the return of the diaphragm to its original position; but if this is not the case, and the respiration is bad and insufficient, introduce a syphon drain, which has cured many bad cases."[1]

[1] Witzel's method of removing an acute pneumothorax resulting from penetrating wounds of the thorax is worthy of remembrance in the treatment of this condition when resulting from pathological causes. This plan, which has been successfully carried out in Trendelenburg's clinic, aims at the conversion of the pneumothorax into an artificial hydrothorax, the latter being finally emptied by aspiration. The procedure is thus described in the *Centralb. f. Chirurgie*, No. 28, 1891 (also *Annals of Surgery*, Nov., 1891): "The bleeding having been arrested, a male metallic catheter is introduced into the pleural cavity through the highest points of the wound, its beak being parallel with the chest-wall. The wound is thereafter closed by sutures both air- and water-tight, with the exception of a little opening at the highest point. The pleural cavity is now generally filled with a solution of boric acid at blood temperature till all the air is expelled through the catheter, and all the fluid is removed by depressing the irrigator, which then acts as a syphon. The case treated in this way progressed very favorably."

ACUTE AND CHRONIC ORGANIC DISEASES OF THE HEART.

By W. H. THOMSON, M. D., LL.D.

Unlike other viscera, such as the lungs, liver, kidneys, etc., which contain within themselves the chief conditions for their specific functions, the heart is but a part of the apparatus of the circulation. Not only, therefore, will disorders of the heart affect the circulation, but the converse is equally important, that disorders of the circulation will affect the heart. We might even say that organic changes in the heart, however striking their signs may be, are serious only in proportion to the signs which accompany them in the circulation, and often it is the presence of the latter alone which leads us to judge that the heart must be wrong. Thus we have long ceased to regard the presence of a cardiac murmur as the chief symptom to establish either the form or the degree of heart disease; still less can it chiefly be relied upon for prognosis or as a guide for treatment. In a case of cardiac dropsy, for example, a physician could better be uncertain about the precise heart-murmurs which he hears than be wholly ignorant of the significance of the signs of general endocarditis and of the tense pulse of the patient. The consideration of heart disease, therefore, instead of resting at the cardiac valves, should include also a consideration of the whole circuit of the circulation. Physical examination of the arteries may afford as important indications of the nature of cardiac disease as physical examination of the heart itself; and the same may be said of signs observable in the venous, lymphatic, and capillary systems. The circulation in fact, is more extensive still in its course, for the rapid effects of a hypodermic injection show that the interstitial fluid outside the capillaries moves at a scarcely slower pace than the intratubular current, and many cases of labored heart-action, leading in time to serious organic changes in the heart, doubtless arise first in a disordered state of the interchange between the intra- and the extra-capillary fluids.

These facts receive a good illustration in the marked difference which exists between acute and chronic diseases of the heart. Acute diseases of the heart, like acute diseases in general, are of the nature of accidents, because their cause is usually external, such as infection

or exposure. Like accidents also, they are local in their seat, and commonly show a tendency to recovery, with or without certain special complications or sequelæ. Chronic affections of the heart, on the other hand, like most chronic affections, are not accidents, but are associated with wider and more general conditions, such as diffused vascular disease or affections of the lungs or kidneys. The treatment of these two classes of heart disease, therefore, often differs as much as the treatment, for example, of acute pneumonia and of chronic pulmonary phthisis.

We can begin, therefore, with the separate consideration of acute diseases of the heart, and we will take them in the order of their frequency in practice, rather than after any anatomical system.

ACUTE DISEASES OF THE HEART.

Acute Endocarditis.

This affection occurs most commonly from the presence of a ptomaïne in the blood, of which the chief is that which occasions acute articular rheumatism. Next to rheumatism, chorea should be ranked. Osler claims that chorea is associated even oftener than rheumatism with inflammation of the heart, but that its development may be so independent of the choreic symptoms that it may not be detected until months after these have subsided. Acute endocarditis occurs in scarlatina with or without rheumatic symptoms; also in measles, and less frequently in diphtheria. It also develops, generally in a subacute form, in both acute and chronic nephritis; of a severe type from corresponding septic absorption in pyæmia; and, again, of a mild type from less-pronounced sepsis in many affections characterized by ulcerative processes, such as typhoid fever, small-pox, phthisis, etc.

As in other acute inflammations, the tendency to local development is illustrated in acute endocarditis by its almost exclusive limitation to the left side of the heart. It would appear as if the inflammatory poison needed arterial blood for its efficacy, for in the fœtus the right side of the heart, which receives the arterialized blood first through its auricle, is as often attacked as the left. To this may be added direct impact, because at the aortic orifice it is the ventricular surface of the valves which is attacked, while at the mitral it is the auricular. The inflammation begins with a reddening of the valves, especially at their lines of junction, where rows of small granulations soon form which are quite analogous to those of an inflamed conjunctiva, and, like these, they soon become sources of further irritation of the smooth, rapidly-

moving lining on which they develop; with this difference, that in the heart the disintegration of the leucocytes which infiltrate the granulations leads to the direct deposit of fibrin upon them from the passing blood. By this means they grow into vegetations of more or less size, sufficient to extend the irritation by friction to the whole valvular surface, and then to the walls of the heart itself. In the case of long vegetations, reaching down into the heart, local ulcerative action may be recognized where the tips of the processes have come thus into contact with the contracting ventricular wall, which may lead even to a circumscribed abscess in the muscular substance. At other times this action is more directed against the root of a valve, causing an ulceration which may perforate it or sever its connection with one of the chordæ tendinæ, or so lead to distortion of the valve in cicatrization as permanently to damage its working.

In many cases acute endocarditis, owing to its limited area, begins with such moderate constitutional symptoms that but for auscultation its presence would not be suspected. Thus in autopsies of typhoid fever and of phthisical subjects it is found to have existed in some without having been detected in life. This fact, therefore, always should lead to frequent examinations of the heart in those acute diseases in which its occurrence is likely. Before auscultation reveals its beginning, however, I have often found, without there being any pericarditis, tenderness on pressure made in the epigastrium upward under the left arch of the costal cartilages at the end of expiration. The patients catch their breath, while the heart gives a few rapid beats from the pain produced. It is important to note that in children with rheumatism endocarditis often develops while both the joint symptoms and the fever are very moderate. Thus a boy, aged twelve years, two days after sitting on the cold ground watching a ball game, complained only of some stiffness of one knee and in the opposite ankle. I found his heart unaffected then, but the next day, though only the knee remained slightly inflamed, endocarditis had already begun, and continued to progress, while the joint symptoms steadily declined. No doubt, therefore, many cases of chronic heart disease, whose origin is unknown to the patients or to their friends, may have begun thus in some early slight rheumatic attack, whose pains were supposed to be of the variety termed "growing pains," and hence children who have passed restless nights with such pains should be frequently examined for cardiac symptoms.

As the inflammation progresses, however, an increase of fever and of pain, referred to the præcordium (by children to the stomach), with palpitation, is the rule. The expression also often becomes anxious, a sign of particular importance in children, as it differs so much in them from the expression of pain. The signs on auscultation in the ordinary form

of this affection are commonly systolic, rarely diastolic, murmurs, oftener at the apex than at the base, and not infrequently of a loud blowing character. The loudness of the murmur is no index of severity, for it is not as serious a symptom as a feeble murmur with disturbance of rhythm and unfavorable general symptoms. The duration of such an attack of endocarditis is very variable, but the prognosis, as far as the existing inflammation is concerned, is good; for the majority of such cases recover, without the patient being aware that a permanent mischief has befallen him. In many instances, however, the pulse remains frequent and the heart irritable for a long time afterward. Its physiological unrest is itself the cause of the delayed subsidence of the inflammation, and hence the difficulty of checking a moderate endocarditis in children, from their being allowed so commonly to get up too soon and to act like other children in their sports.

In more severe cases of acute endocarditis the pain, fever, and rapid or irregular heart-action may be much more pronounced, and the distress of the patient from them be very evident. But in other cases these symptoms may be comparatively slight and the temperature low, while the constitutional symptoms are very grave, resembling the terminal stages of typhoid fever, meningitis, or general tuberculosis. One manifestation, however, should at once suggest endocarditis instead of these diseases, and that is ecchymoses on the skin, with or without hæmaturia. These are due to a stream of fibrinous emboli sent into the circulation from their soft-clotted sources in the heart, the larger ones when arrested in some viscus often occasioning rigors with elevation of the temperature, so as to simulate remittent fever. The course of these cases may be prolonged for many weeks. The prognosis is bad: the pulse is rapid and feeble, the patient being sometimes much distressed with dyspnœa or attacks of syncope or other signs of the formation of heart-clots, while others die after severe cerebral symptoms, such as delirium or stupor, or with signs of intercurrent inflammation from infection of the lungs, liver, spleen, or kidneys. Recovery, however, does occur in some, even after they have shown ecchymoses quite extensively.

Treatment.—Naturally, the first indication is to deal with the blood-poison which is causing the inflammation. As regards the commonest agent of the kind, I have little doubt that heart inflammations have increased in frequency since the introduction of the salicylates in the treatment of rheumatism, compared with the time when the alkaline treatment was more generally followed. That a full, and not a partial, recourse to alkalies will render carditis in any form uncommon in all patients, except children, with acute rheumatism, I believe as implicitly as did Fuller himself. That either form of treatment has much advantage over the other in shortening the

real duration of the rheumatism is very doubtful. That the salicylates do relieve the accompanying arthritis the soonest and best no one can deny, but the blood most highly charged with them is just as likely to inflame the heart as it is without them—just as rheumatism in childhood shows that there is no necessary connection between the severity of the joint-symptoms and the liability to carditis. Not so the alkalies. When they are given promptly and with the one object speedily to alkalinize the urine and to keep it alkaline, the heart may be reasonably regarded as safe from serious attack. For this purpose it is not enough simply to give alkalies, but a relative excess of alkalies in the blood and in the secretions must be secured, and to do this may require persistent and free dosing for prolonged periods. For this purpose I prefer Garrod's treatment, with 40 grains of the bicarbonate of potassium and 5 grains of citric acid, every two hours continuously till the urine is not only rendered alkaline, but remains so for twenty-four hours, when the same doses may be given every three or four hours, according to the tendency to revert to acidity. By this medication, when in adults the symptoms of rising fever and of the extension of joint-inflammations point to approaching heart mischief, we secure not only prophylaxis, but also may arrest a carditis already begun. German writers (Traube, Leyden, Fraenzel) maintain that in acute rheumatism an actual dilatation of the heart may be demonstrated by the extension of the area of percussion dulness, without there being any endo- or peri- or myo-carditis present, and that on the subsidence of the rheumatism the heart regains its normal dimensions. If this be so, it indicates a tendency of the heart-muscle to be so weakened by the rheumatic poison that the resulting dilatation may dispose to valvular inflammation from strain by the impact of the blood-current when the valves are not yet adjusted to the dilatation, and the detection of this condition may afford another reason for an early resort to alkalies. Meantime, the alkaline treatment does not exclude the employment of the salicylates from the beginning for their analgesic effects, and therefore I long have been accustomed to prescribe the latter alone at the commencement of acute rheumatism, and then to diminish or to intermit their use so soon as heart-complications seem to be threatening.

Another indication in the treatment of acute endocarditis is to slow the beats of the heart itself. When, compared with other acute inflammations with similar symptoms, it is noted how insignificant are the structural changes which a rheumatic inflammation produces in other textures, it is evident that another factor besides the rheumatism is needed to explain the severity of the heart lesions. A knee-joint with the same amount of pain and swelling from any other cause of arthritis would probably not fully recover therefrom, while in acute rheumatism

it may part with its inflammation by transfer to another joint in one day. That factor which induces organic changes in the heart is indicated, doubtless, by the contrast between the joint kept motionless when it is attacked and the inflamed valve vibrating a hundred times and more a minute. This surmise is further borne out by the effects of the rheumatic inflammation in another unresting texture—the pleura; for rheumatic pleurisy resembles the cardiac more than the joint inflammations in consecutive damage.

To quiet the heart in endocarditis aconite is the preferable sedative, for its specific analgesic property renders it superior to the simply slowing action of veratrum viride. Five drops of the tincture every three or four hours, according to the effects, will often cause a marked improvement in the heart-symptoms, and if there be much pain Dover's powder is an excellent adjuvant to the aconite. In those cases with quick, feeble pulse and grave general symptoms aconite is contra-indicated.

Another measure, often not as sufficiently attended to as its relations to such an inflammation require, is protection of the surface. While there is no direct vascular connection between the skin and the internal viscera, the general law of a close relationship between the vaso-motor nerves of an internal part and that of the corresponding cutaneous area has many important therapeutic applications. On this law are based not only the uses of counter-irritation, but also those of all external applications in the treatment of internal inflammations. The quick start of the heart in health on a sudden application of cold to the præcordium is an illustration of this sensory association. But in all inflammatory states of internal organs this normal sensitiveness to cutaneous impressions is much increased. A person with an acute coryza will know that a cold draught is coming from some source which he would be quite unable to appreciate in his usual condition. There can be no doubt, therefore, that an acute inflammation of the heart can be much aggravated by a neglect to protect the affected side of the chest from chill. It is rare to have that region laid bare in health, either by day or by night, and yet I have seen physicians expose the chest of perspiring patients with acute rheumatism and a carditis to an unjustifiable extent and time while making their examinations; and on one occasion, I doubt not, with fatal result in a case of commencing pericarditis, in order that a class of students might hear the friction-sound. We should pursue instead the opposite course, not only by providing a special covering for the surface over the cardiac area, but also by the sedative effect of moist heat along with a variety of anodynes. Poultices mixed with extract of hamamelis and laudanum, and covered with oil silk, could be used by day, while at night it is preferable to saturate a flannel with linimentum opii 4 parts and

linimentum chloroformi and linimentum aconiti, each 1 part. I have also long found a recommendation of Dr. T. K. Chambers of great service, that all patients with acute rheumatic inflammations should lie between blankets. This gives relief at once to the tender joints, whose hyperæsthesia is much aggravated by the rubbing of the sheets when wet through, as they often are, with acid perspiration, while the blankets serve much better than sheets to prevent further rheumatic inflammation or relapses from chill. I have no doubt that perspiration, especially at night, is a potent cause of intensifying or prolonging an attack of rheumatism. Under the present sway of microbism the view is widely maintained now, especially in Germany, that acute articular rheumatism is a bacterial disease. But bacteria alone are not sufficient in any disease, else tuberculosis, for example, would be universal, and in rheumatism one condition is necessary for the supposed microbes to initiate this disease, and that is the chilling of the skin when wet. Acute rheumatism is therefore endemic both in cold wet climates and in dry deserts like Arabia, from exposure of the moistened skin to cold—a constant experience among their inhabitants. The Bedouin Arabs, to my personal knowledge, are exposed to great changes of temperature from the rapid radiation of the heat from the desert at night, so that, on going to sleep soon after sundown with a torrid temperature in their tents, they often awaken in the early morning with a wind so cold that a European would find a winter overcoat welcome.

The perfect protection of a patient with a rheumatic carditis from surface cold is therefore as important an indication as any other in his case; and for the same reason during the subsidence of the inflammation, when the heart remains irritable for so long a time, it is well to order a large belladonna plaster to cover the whole cardiac area. As remarked above, no case of carditis should be allowed to get up too soon. The progressive nature of the heart affection in this stage of subacute inflammation is too often illustrated by the after-history of those patients who cannot be persuaded sufficiently to avoid all influences which increase the frequency of the heart-beats.

In the treatment of the types of endocarditis described above, with grave constitutional symptoms, we have to rely mainly upon free alcoholic stimulation. Unless the temperature exceeds 103°, we may hope for benefit from 20-drop doses of the tincture of the chloride of iron. Quinine and the coal-tar derivatives are mischievous from their weakening effect on the heart. I had one case which seemed to improve remarkably from drachm doses of Labarraque's solution of chlorinated soda, given freely in milk and water. I was led to do this from my constant use of this medicine in scarlatina, and in which it also acts well on the cases with rheumatic symptoms. In the endocarditis occur-

ring in acute nephritis frequent warm baths seem to do good, not only to the renal affection, but also to the cardiac complication by their sedative effect on the heart.

Malignant Endocarditis.

Instances of this severe malady are not of uncommon occurrence in hospital wards, but three cases in private practice afford good illustrations of its protean symptomatology, as well as of its more common types.

A lad of fourteen was brought to me as a case of chronic ague, with extreme anæmia, of five months' duration. Though repeatedly examined by myself and by more than one distinguished consultant, yet no cardiac murmur or other heart-symptom could be found to account for the transient appearance of reddened spots on different parts of the body, generally in the neighborhood of joints, whenever he had one of his severe chills with fever and sweating, and which occurred usually every seven days. During the intervals his temperature was normal or subnormal. At last a chill occurred which was followed by the rapid development of endocarditis, pericarditis, high fever, delirium, hemiplegia, and death. A localized ulceration on the left aspect of the ventricular septum was the probable origin of his disease, as it would account for the long absence of valvular signs.

The second case began with a follicular inflammation, which developed into small abscesses in the tonsils of a middle-aged gentleman, and which, as usual with him in former attacks, was followed after a week by rheumatic symptoms in his joints, though never before had his heart been involved. At this time he was under great mental depression, owing to financial losses, and he soon showed such serious symptoms of prostration and excessive sweating that the diagnosis of malignant endocarditis was early made, though the only heart-signs were pronounced disturbance of rhythm and rapid, weak pulse. He became obstinately taciturn, and, after developing double pneumonia, he died comatose. It was the right side of the heart which became affected first in his case.

The third case was that of a gentleman, aged sixty, with chronic sclerotic valvular disease and dilatation of the left ventricle, who, by proper treatment, had recovered a few months previously from pulmonary œdema and general anasarca; but after a dysenteric attack, induced by careless eating, his heart-symptoms suddenly became aggravated. General dropsy rapidly developed, with great dyspnœa, followed soon by cerebral symptoms, and then by a most extraordinary appearance of ecchymoses over the whole body. After death the universality of these hæmorrhages in even mucous and serous membranes,

as well as in the parenchyma of the viscera, would suggest a sort of bacterial spray from the aortic orifice to account for them.

In this disease rheumatic antecedents are but rarely noted, and then, with few exceptions, only as long-past occasions of chronic valvular disease. Long-standing organic heart-lesions, however, of whatever origin, seem to be potent predisposing causes for developing the affection. Next come infective forms of pneumonia, with the further not infrequent complication of purulent meningitis. Next, traumatic infection from some external source, such as a slight wound in the foot from paring a corn, or from a furuncular inflammation, or from a phlebitis common in the uterus after abortion or in puerperal fever. In these the right side of the heart is first attacked, and the auricular surfaces of the mitral valves secondarily, with pulmonary complications as the rule. In some cases, however, the infective source is not discoverable. Nor can it be said that the microbic invasion has been demonstrated yet as of one specific kind, the commonest form found associated with purulent foci being the *Staphylococcus pyogenes aureus.* On the other hand, in many cases pus is found nowhere, either in the heart itself or in the affected tissues. The proposed name of "ulcerative endocarditis" for this affection will not cover all cases, as there are some in which no ulceration can be found in the heart. Usually, however, large fungous vegetations are found with extensive ulceration at their bases, or the ulcers may be clean cut and eroding, or perforating the valves or even the septum, or else by means of abscesses extending through the muscular parietes of the heart till a purulent pericarditis is induced. Meantime, the systemic symptoms are of all the varieties which the infected blood-current may induce in its circuit—sometimes pulmonary, sometimes cerebral, gastro-intestinal, renal, etc., rendering the diagnosis often a matter of guesswork, especially as these secondary affections may afford much more distinctive signs of their own than the heart itself does. The fever, when pronounced, which is not always the case, is of the pyæmic type, but in chronic ulcerative states it may closely resemble ague in its quotidian or tertian stage, or, as in the case of the boy above mentioned, of the hebdomadal type. At other times it has the characters of a remittent fever.

The disease can scarcely be otherwise than inevitably fatal, and the treatment therefore can be only palliative of the urgent symptoms.

Acute Pericarditis.

As fractures are classified by surgeons into simple and compound, not because the latter term implies more extensive or serious breakage of bone, but because a new element is introduced into the case by communication with the outside, so pericarditis may be termed simple when the pericardium alone is involved, and compound when there is

peri-pericarditis as well; for the course and ultimate results of the affection are much modified by such extension in the majority of cases. Thus, complete obliteration of the pericardial cavity by the adhesion of its two layers is not infrequently found at autopsies, without much appearance of damage to the heart therefrom; but, as will be shown in speaking of chronic diseases of the heart, adhesions of the pericardium to adjacent parts, such as the chest parietes, or to the pleura, often lead to progressive structural changes which entail the severest results of heart disease.

Acute pericarditis is most commonly induced by the causes enumerated above as those of endocarditis, such as acute articular rheumatism, etc. A neighboring pleurisy—more commonly, therefore, of the left side—may also be added. But the pericardium has its own inflammation besides in the form of a tubercular pericarditis, which may be entirely primary, though usually it is associated with a general tendency to tuberculosis of the serous membranes. It is curious that tubercular pericarditis is more common among elderly than among young subjects. In this form, as well as in those cases which occasionally develop in the course of scurvy and purpura, the accompanying effusion is apt to be bloody. In rheumatic cases the effusion is serous or sero-fibrinous; in nephritis, more watery; while it is purulent in ulcerative endocarditis, pyæmia, and eudocarditis from extension of an empyæma. If life be prolonged long enough in purulent pericarditis, the pus finds an outlet in the most various directions, as would any other abscess in moving parts. Finally, pericarditis may be induced by chronic endocardial and aortic lesions, by new growths in the mediastinum or from the œsophagus, bronchial glands, etc., and by various traumatisms.

The temperature in acute pericarditis is not often high, ranging from 101° to 103°, and in chronic cases it may remain normal. At the beginning of the acute inflammation the changes are the same as in any other inflamed serous membrane. But ere long the rapid movements of the pericardium cause the exudation, whenever it is not quite fluid, to assume the "honeycomb," "shaggy," or "butter" membrane appearance, when the two layers are separated from each other, or it may show irregular rolls lying between free flakes. The effusion when liquid may be moderate in amount, or so abundant as to measure from a pint to a quart or more.

The symptoms of pericarditis depend upon the conditions, and hence the diagnosis may be either very easy or quite the opposite. When it occurs in acute rheumatism, for example, it may be only by auscultation that its presence is revealed. In the first stage, præcordial pain, as might be expected in the case of a tough membrane, is more pronounced than in endocarditis. When constituting more than uneasi-

ness or tenderness the pain may be described as cutting, tearing, or burning, and sometimes as radiating to the left shoulder or down the left arm, and it is often accompanied with nausea or vomiting. The pain also leads to restriction of the movements of the diaphragm, so that, though the patient moves his legs freely, he keeps the trunk perfectly still. Locally, there is tenderness on pressure over the intercostal spaces and left side of the epigastrium. A short, hacking cough is frequently present, which if continuous should suggest the further complication of diaphragmatic or lateral pleurisy. The pulse remains strong, full, and excited even when effusion has set in, and it is diagnostic to find these characters while the impulse is enfeebled by the interference of liquid in the sac. When the effusion, however, becomes sufficient to embarrass the diastole, the pulse alters remarkably. Palpitation meantime is very common.

In the first stage of pericarditis, however, it is by auscultation that conclusive evidence is obtained in the presence of the characteristic friction-sound. It may be heard most plainly where other murmurs are but rarely heard, as over the pulmonary artery at the base, or equally over both ventricles, but it distinctly fails to be transmitted in any direction away from the heart. Though double, yet its sounds are not exactly synchronous with either of the heart-sounds when these can be also heard, and it is more superficial than are endocardial murmurs. At first the friction-rub may be of a grazing character, then louder and more crackling, like the crumpling of paper, or creaking, though very rarely musical. It also often varies with position, being clearer when the patient sits up than when lying down.

With the increase of the effusion the symptoms generally become much modified. The pain moderates and the murmur disappears. The breathing becomes labored and shallow; the patient lies with the head high, or he may have to sit up. The expression becomes anxious, the countenance paler and somewhat cyanosed, the pulse more rapid, smaller, and weaker, and in bad cases quite irregular. The veins of the neck are enlarged as a result of increasing stasis, and they may show many undulations. Delirium is common, or the patient may become irrationally taciturn. The signs on physical examination are now dependent on the effusion. The apex-beat may hardly be detected by the touch, but be strikingly visible to the eye as diffused upward above the nipple, with a distinct undulatory movement. The præcordial region is bulging, the intercostal spaces widened or obliterated, with sometimes the further unfavorable symptom of cutaneous œdema, indicating probable diaphragmatic pleurisy. Percussion shows marked enlargement of the area of cardiac dulness, which may extend from the clavicle above to the diaphragm below, making a triangle with its obtuse apex at the sternal junction of the left first rib, one side passing downward

through and beyond the left nipple, the other more vertically midway between the right nipple and the median line of the sternum. An important sign is the modification of the boundaries by change of posture, increasing transversely when the patient sits up, and diminishing when he lies down; and it is further significant that the dulness extends beyond the position of the apex-beat. If the pericardial murmur continues now in any form, it is changed into irregular jogs, which are more numerous than the endocardial sounds, which may be distinctly heard, though distant and muffled. In fatal cases the failing pulse may seem to be suspended during inspiration or cough, while restlessness, especially of the arms, rambling, or maniacal delirium, and lastly—particularly in rheumatic cases—convulsions and coma, terminate the scene.

Recovery from pericarditis often occurs more rapidly and completely than from endocarditis, the whole course lasting not more than a week, and leaving no signs during the subsequent life of the individual. In other cases the absorption of the fluid is more gradual, and as its components solidify the friction-rub returns louder and coarser than before, so that a friction fremitus may be felt by laying the hand over the part. More pain may now again develop, with palpitation, but, as a rule, the gradual diminution of all symptoms is progressive, till, by more complete adhesions forming between the two layers of the membrane, the friction-rub itself disappears. The exudation becomes in time converted into an imperfect form of connective tissue, which may be thin and delicate or thick and tough, or even extensively calcareous. There are no means of certainly diagnosticating such simple adhesions during life, for, unlike external adhesions of the pericardium, they rarely give rise, except in the calcareous form, to definite disturbance of the heart's functions.

Treatment.—The dangers of the attack itself are greater than in endocarditis, and are due in the first place to the amount of compression of the heart by the effusion; secondly, to the greater tendency of pericarditis to involve the heart-muscle; and lastly, to the liability of extension of the inflammation to the pleura or lungs.

The indications, therefore, are to moderate the inflammation as soon as possible; and here, as in endocarditis, the rapid action of the heart is to be regarded as the inevitable and yet serious complication of the inflammation, and therefore it is the first thing to attend to. Pain is the leading cause of both the excited and the irregular cardiac beats which constitute the symptom of palpitation. Hence in the first stage of the affection, when the pulse is full and strong, opium and aconite are invaluable, and should be given in full doses according to the age of the patient. When the effusion begins to tell on the circulation, they should be given up. Hot anodyne fomentations

covered with oiled silk should likewise be assiduously continued until the symptoms of the second stage begin, when they too should give place to the application of mercurial ointment with a flannel under the oiled silk covering. This old-fashioned remedy is of real service, in my opinion, throughout the subacute stage of the inflammation, and for a long time afterward in cases of external adhesions. In the acute stage German writers generally advise the application of the ice-bag. My experience with it has not been favorable after giving it a fair trial in hospital practice. When the effusion weakens the heart, digitalis and stimulants, like drachm doses of Hoffman's anodyne, with whiskey or brandy are required. The pulse-characters should be our guide rather than the signs of effusion alone, for accompanying myocarditis may be the cause of the flagging pulse and of the cyanosis, while the area of cardiac dulness may be but moderately increased. All except the most necessary movements of the patient should be avoided, for it is often noticeable how long the increased frequency of the heart-beats continues after such exertion as sitting up occasions, and which, when the pulse is irregular, may cause fatal syncope. When the effusion seems stationary, and not before, a blister to the whole præcordial region is often very beneficial, but it should not be prescribed in nephritis, for the tendency to effusion then is not from the local inflammation only, but is part of a general condition. In rheumatic cases the alkaline treatment should be persevered with, but all salicylates stopped.

If, however, the symptoms due to the effusion increase, an exploratory introduction of a hypodermic needle should be made, with proper antiseptic precautions, in the fifth interspace near the sternum, but not too near, on account of the internal mammary artery. This preliminary operation is needful, for we cannot be certain otherwise of the degree of removal of the heart from the chest-wall by the fluid. If fluid be withdrawn readily, we then can use the aspirator without fear; and it is often striking how a moderate abstraction suffices to improve the whole aspect of the case. Experience has shown that the dangers arising from puncture of the heart itself are but slight. For purulent pericarditis nothing else than evacuation of the contained fluid can be done, and if the aspirator fails a proper trocar and canula should be used.

The after-treatment of pericarditis should be according to its exciting cause. Restoratives of all kinds are indicated, except that in every form of rheumatism iron is mischievous, while in nephritis it does good combined with tincture of nux vomica and sweet spirit of nitre. It is only in convalescence that the iodide of potassium has seemed to me beneficial; it should be given in small doses, not more than 5 grains, and long continued. I have thought that it allays a tendency to pal-

pitation, and I give it in combination with the tincture of belladonna. Nothing, however, so quiets the heart and improves the symptoms of patients convalescing from any form of carditis as to have them wheeled out in mild weather to spend hours on a porch or verandah.

Tubercular Pericarditis.

This affection may develop suddenly as a primary disease, but otherwise it is not always easy to make out its existence. The effusion is often bloody, as previously stated, and the exudation may be so soft that it produces no positive sound. The patients very commonly have tubercular pleurisy as well, and in any case this form of pericarditis is prone to become complicated with external adhesions. If cardiac symptoms, such as great weakness of the pulse, cyanosis, and more dyspnœa than the pulmonary lesions will account for, develop in patients with well-marked phthisical tendencies, we may suspect tuberculosis of the pericardium and watch for the signs of effusion, etc. The application of a blister is indicated in this form particularly, while the case is otherwise treated according to the special symptoms present.

Hydro-pericardium.

Simple dropsical accumulation in the sac, without inflammation, does not occur as an isolated affection, but in conjunction with similar collections in other serous sacs, and therefore most commonly in chronic Bright's disease with anasarca. I have seen it, however, quite pronounced when there was but a moderate collection in the adjacent pleura. It may then have occurred as the result of a low grade of inflammation which was not enough to affect the temperature. The treatment should be that followed for the general disease, together with the local application of mercurial ointment.

Acute Myocarditis.

This is a very different affection from the so-called chronic myocarditis or chronic fibroid disease of the heart, and it consists of a true acute inflammation of the muscular walls, so that the fibres become softened, and under the microscope show the characteristic changes of inflammatory processes in muscular tissue. It is a not uncommon accompaniment of acute pericarditis, and to a less degree of endocarditis, but it is then generally limited to the muscular fibres most adjacent to the inflamed membrane. As previously mentioned, it may consist of a localized extension of ulcerative endocarditis, with abscess-formation, but in any case this associated myocarditis is not recognizable by physical signs, and can only be inferred by its occasioning more weakness of the heart's action, with dyspnœa and cyanosis, than the primary disease seems to account for. Acute myocarditis, however, undoubtedly

does occur in some cases by itself without either endo- or pericarditis, as has been shown by G. West in England, and Koster, Ruehle, and Leyden in Germany. The cases reported, with confirmation by autopsy, mostly occurred in connection with acute rheumatism, or else were associated with cirrhosis of the liver in drunkards. The symptoms during life which led to the diagnosis were accompanying acute rheumatism with serious heart symptoms, without signs of valvular or pericardial implication, or without rheumatism, yet with the same symptoms of great cardiac dyspnœa, cyanosis, weak heart-action, and delirium. As cirrhosis of the liver is particularly apt to be accompanied by degeneration of the muscular tissues generally, it is probable that this condition may occasionally take on an acute form in a heart previously weakened by alcohol, but the frequent presence of acute rheumatism in the cases reported leaves no doubt that a true primary myocarditis may be set up independently in rheumatic fever; and Ruehle claims that this happens oftener than is generally supposed. That myocarditis may be the chief cause of the fatal course of a rheumatic endo- or pericarditis is readily granted, but as a separate affection it certainly is not common in this country. The recognition of its possible existence, however, is serviceable if only to prevent a too exclusive reliance on physical signs in the diagnosis and prognosis of heart affections. The absence of murmurs or of increased area of dulness on percussion should not cause us to rest easy in the presence of cyanosis and of failing, irregular pulse. The treatment of this affection is of course the same as that of like conditions in other cardiac inflammations.

CHRONIC DISEASES OF THE HEART.

A CHRONIC structural change in the heart resulting from an acute process is not always synonymous with chronic heart disease. Thus acute endocarditis occasions a variety of changes in the mitral and aortic valves which long may indicate their presence by their characteristic murmurs, and yet in time these may wholly disappear. That many such cases outgrow the valvular trouble, especially mitral lesions, there can be now no doubt. The majority even of those in whom valvular murmurs permanently continue do not have their health unfavorably affected for years, and in many of them the duration of life is not appreciably shortened. Sir Andrew Clark reports 684 cases of chronic valvular lesions in his own experience which had been observed for five years, without the health having been disturbed by the state of the heart. An old valvular damage, however, soon becomes a serious matter when certain influences or states begin to

strain the heart, and hence in no class of diseases is it so important to take account of the general, in distinction from the special or local, conditions as in chronic diseases of this viscus. Thus, judged by post-mortem appearances alone, it may be difficult to decide whether the valvular changes were the chronic results of acute processes, or were caused by acute processes supervening upon chronic lesions. But the clinical history and aspect of the case will afford valuable assistance toward estimating the share of intra- and extra-cardiac influences in producing the symptoms, as well as their order in time; and hence we prefer to classify the various chronic affections of the heart into the primary, or those caused by some lesion in the heart itself, and secondary, or those which are produced by disorders of the circulation.

Chronic Valvular Disease.

Chronic primary valvular disease may arise from an endocarditis during fœtal life, the right heart being then liable to attack, as previously stated; so the commonest congenital form of valvular heart disease is either incompetence or stenosis of the pulmonary valves. As articular rheumatism, chorea, and scarlatina are commonly affections of childhood or of youth, so primary valvular heart disease oftenest occurs before thirty years of age, to give place then to progressive liability to the various forms of secondary valvular disease. Of the primary forms, mitral incompetence is the most frequent, aortic stenosis the next, mitral stenosis the next, and aortic incompetence the least frequent. In the order of seriousness there is little difference between them, when the valvular damage itself is moderate; but when it is considerable, much the worst valvular disease is aortic incompetence, next mitral stenosis, next mitral incompetence, and last aortic stenosis. As the chronic inflammatory processes induced through the imperfect working of the valves by the initial inflammation scarcely can be limited to only one aspect of the valves, so it is very common to find them result in both stenosis and incompetence of the affected orifice. Thus, mitral stenosis may begin with an inflammation of the auricular surface, which unites the edges of the two segments by a growth of connective tissue, sometimes infiltrated also with calcareous matter. This process, however, may extend to the chordæ tendinæ below, and mat them together into a fibrous cord whose contraction draws the valve down into a funnel shape with a small slit in it, constituting the "buttonhole" mitral, reducing its opening to one-third its normal size. But, on the other hand, the effect on the chordæ tendinæ may be the reverse of this, for they may become so elongated that they allow the valves to flap back, with consequent regurgitation into the auricle. Other contraction changes in the valves may keep them open, and yet narrowed in both systole and diastole, with the production of

double murmurs accordingly. The sigmoid valves of the aorta may undergo the same changes, so that aortic regurgitation is very commonly preceded by a stenotic murmur. The valvular changes in aortic incompetence, as a rule, are more extensive than in any other form of valvular disease, owing to the great force of the recoil of the aorta, especially as this increases with age. The slow inflammatory process may then extend to the aorta itself, and with aortic dilatation we may find a valve so thickened and distorted that it is turned into the semblance of a large vegetation flapping back and forth in the blood-stream, with a distinct musical vibration.

The effects of these lesions will vary, of course, according to the valves involved and the extent to which they are altered. The systemic effects of mitral lesions are ultimately those of failure of the right or venous side of the heart, with the intermediate stasis of the pulmonary circulation added. In a case of primary disease of the right heart from pulmonary emphysema and old bronchitis the liver becomes chronically engorged, so that its lobules show the "nutmeg" appearance caused by a white zone of fatty cells enclosing red-and-yellow-looking tufts of hepatic and portal capillaries and distended bile-ducts. It is this condition of the liver which gives the yellow tinge to the complexion of such heart-disease patients. As a further result of portal embarrassment there are also gastro-intestinal symptoms, such as flatulence, anorexia, and heaviness after eating, constipation, and hæmorrhoids. The urine is diminished in quantity from a like condition of the kidneys, but it is important to mention that it may be quite albuminous, with numerous casts. The albuminuria and the casts may soon disappear with the improvement in the heart. The enlargement of the liver affords, besides, an indication that the kidney affection is not primary, but is due to the embarrassment of the heart; for in cases of original Bright's disease associated with consecutive heart disease the liver is not much enlarged, if at all. Finally, the increasing venous stasis tells upon the external circulation. The ankles begin to be œdematous; then the dorsum of the foot; and an ascending dropsy ere long reaches the body, with ascites and general anasarca, from which the face may or may not be wholly free, according to the state of the kidneys. These disorders in the return circulation may follow disease of the right heart alone, the left cavities then being small and contracted because of the diminished flow from the lungs, so that the general arterial circulation is relatively lessened, with a correspondingly small pulse. It is, however, a more curable state than disease of the left heart, for the right heart both dilates and recovers from dilatation more readily than the left does. Hence the prognosis is more serious, if the right heart fails from disease of the left, when the pulmonary stasis against which it has to contend is of

mitral origin. In mitral stenosis especially the engorgement may be so great, with paroxysmal exacerbations, that a profuse hæmoptysis may occur, and blood be found after death effused in small scattered or in large masses in the lung-tissue itself. For some unexplained reason, these collections of so-called "pulmonary apoplexy" occur oftenest at the base of the right lung. A longer stasis may block the capillaries, so that the alveoli become almost obliterated, causing the dense heavy condition termed splenization of the lung, while a more chronic state still induces interstitial growth of connective tissue, thickening of the alveolar walls, deposit of pigment, varicosity of the veins, and atheroma of the pulmonary arteries, producing the appearance to which the terms "brown induration" or "brown indurated pneumonia" are given.

In mitral stenosis the pulse is characteristically small, and in bad cases irregular as well. The diminished quantity of blood in the left ventricle generally causes it to be small and contracted. If it be found hypertrophied instead, the presumption is that mitral incompetence occurred first, during which the ventricle enlarged, and that the stenosis developed afterward. The right ventricle, on the other hand, is always enlarged to compensate for the obstruction in the pulmonary circulation, so that with the smallness of the left ventricle the right may extend to the normal position of the apex-beat, causing the characteristic stenotic murmur to be heard more toward the middle of the sternum.

Mitral incompetence, which is the commonest of valvular lesions, may be caused by the structural changes above mentioned, or simply by the general distension of a dilated left ventricle. As with each systole a part of the blood regurgitates into the auricle, the latter chamber becomes distended with the blood received both from the lungs and from the ventricle; and hence with the succeeding diastole a larger quantity of blood than normal flows into the ventricle. This entails heavier work on the ventricle, and leads to its hypertrophy; but unless the regurgitation be too great, the blood sent into the aorta, if there be no stenosis there, is fair in amount and the pulse remains normal, but without tension, as this is prevented by the mitral reflux. So long as the right ventricle by its increased strength keeps up the resistance in the left auricle to the mitral regurgitation, the heart may go on filling the aorta so regularly, and the pulse be so natural, that this condition may last for an indefinite time without any sign save the mitral murmur to indicate its existence. Whenever the incompetence of the mitral, however, so increases that the right ventricle fails to balance it, or when the latter itself yields and dilates in turn from such an added strain as a bronchitis, then primary mitral

valvular disease shows all the results above described of venous embarrassment in the lungs and throughout the system generally.

Aortic stenosis is a common result of acute endocarditis, but is usually then not sufficient to produce serious obstruction to the circulation, as compensatory hypertrophy promptly follows and the pulse remains normal in most of its characters. It is quite otherwise in the chronic endocarditis of secondary valvular disease, especially in elderly patients, for the aortic orifice may have become very much narrowed by the thickened and calcareous valves, with the result of causing the pulse to be intermitting, small, and particularly slow, sometimes only from twenty-five to forty a minute. There may then develop symptoms of cerebral anæmia, such as vertigo, syncopal attacks, or epileptiform convulsions, which differ, however, from true epilepsy in being accompanied by a remarkable fall of bodily temperature. In both mitral and aortic stenosis, as well as in aortic incompetence, the imperfect supply of arterial blood leads very commonly to a general lowering of nutrition or emaciation, which presents a striking outward contrast to the swollen contour of patients with venous engorgement.

Aortic insufficiency may result primarily from endocarditis, and secondarily from chronic atheromatous or calcareous changes, spreading to the semilunar valves from the intima of the aorta. It may also follow upon overstrain, and hence does not occur among women as often as among men, especially those who have to lift heavy weights in their customary work. As previously remarked, the powerful recoil of the aorta tends besides to aggravate the reflux into the left ventricle during diastole, and as the quantity of blood thus accumulating in the ventricle from both its orifices is, on that account, constantly great, the tendency to hypertrophy and dilatation is the most pronounced in this of any of the valvular lesions. Secondary incompetence of the mitral valve is therefore very likely to occur, and, as this soon leads to hypertrophy of the right heart, the whole organ often grows to such a size in all its cavities as to merit the term "bovine," or ox heart. The effect of this condition of the left ventricle on the circulation is peculiar. The initial yielding at the origin of the aorta paralyzes the arterial tonus throughout the body; the great fulness of the ventricle causes an abnormally large amount of blood to be thrown into the aorta with each systole, whose unresisted wave can then be followed to the smallest arterial terminals. If the arm be flexed at the elbow, the brachial artery may be seen to move in its sheath along four to eight inches of its course. Even the color of the nails may be seen to vary with the pulse, especially on raising the arm, and an erythema of the skin produced by friction may similarly change its tint. Meantime, the large but very short pulse-beat, followed quickly by a sensation of collapse caused by the regur-

gitation into the ventricle, constitutes that characteristic variety to which the name of "water hammer," or Corrigan pulse, has been given. Such patients sometimes complain of anginose pains, referred to the region of the heart or radiating to the left shoulder and arm; but the irregularity of the arterial flow is most felt in the cerebral circulation, especially on suddenly rising, when sensations of giddiness come on, or dimness of vision, or syncopal attacks which may be quickly fatal. On the other hand, it is not uncommon for patients to live many years in active life without material discomfort and with a healthy look, for not until mitral incompetence complicates the case is the complexion changed.

Stenotic valvular disease of the right heart is uncommon except as a congenital affection. Secondary tricuspid incompetence, however, is a frequent result of mitral lesions, and, as is usual with strained valves during the development of dilatation, the tricuspid may show signs of recent endocarditis at autopsies. The chief indication of the presence of tricuspid reflux is a venous pulse, to be seen in the jugular veins, especially the right, and to be felt sometimes in the liver by placing one hand on the epigastrium and the other in the right loin, when the whole organ seems to throb, probably because the liver veins have no valves, and thus easily transmit the cardiac regurgitation.

The symptoms due to the systemic effects of the heart lesions which have been described should always be noted first, before physical examination of the heart is resorted to, because they not only serve as guides to interpret the latter, but they may settle the nature of the case when the physical signs are relatively obscure or wanting. Systematic examination of a case of heart disease, therefore, should begin with the signs to be appreciated by the eye, then those which are detected by the sense of touch next, and those by the ear last. We should at first look the patient over. Simple anæmia and emaciation may imply pure mitral stenosis or aortic incompetence; extreme anæmia with ecchymoses, severe or malignant endocarditis. A yellowish tinge of the countenance and of the conjunctiva goes with tricuspid regurgitation, secondary to mitral disease, and this is still further assured by seeing the veins in the neck traversed by wavy pulsations. Entire absence of lividity suggests uncomplicated aortic lesions. A bluish tinge, especially of the lips, indicates failing propulsive power in the heart, which may be due to simple over-distension, to myocarditis, to the pressure of a pericardial effusion, or to mitral stenosis or incompetence. Visible arterial pulsation, especially at the bend of the elbow, is almost decisive of aortic incompetence. Œdema, beginning at the feet, indicates primary or secondary failure of the right heart as the origin of the dropsy, while its absence from the face suggests that the kidneys are not yet affected. Inspection then notes

the presence or the absence of the characteristic cardiac dyspnœa, with the consequent great difference in prognosis. Dyspnœa due to any form of pulmonary derangement, whether in the respiratory passages, lungs, or pleura, is invariably accompanied by a local or general interference with the lateral and antero-posterior movements of the ribs in breathing, and with an increase of the vertical movement instead. But in cardiac dyspnœa the ribs move naturally, and the patient acts as a person out of breath from running. The patient therefore does what he never does with any form of pulmonary dyspnœa—holds his breath from time to time to restore the rhythm between the action of the heart and the respiration, to the derangement of which his dyspnœa is due. He often closes his mouth to do this, whereas if he strives to check his breathing from pleuritic pain the mouth remains open. Orthopnœa is always due to bilateral embarrassment, and hence is absent in unilateral pleurisy, pneumonia, and phthisis, but present in croup, bronchitis, and asthma. It is therefore also present in severe cardiac dyspnœa, but the mobility of the chest at once distinguishes it from asthma or bronchitis. Finally, it may be regarded as a general law that when dyspnœa is caused by muscular exertion, it is far more indicative of cardiac than of pulmonary derangement. The signs accompanying the cardiac movements proper should then be looked for. There may be no apex-beat visible, or it may be displaced from its normal position an inch below and within the left nipple, to the right by a pleuritic effusion, or upward by abdominal distension, or it may be extended downward and outward by enlargement of the left ventricle, or to the right with epigastric pulsation in pulmonary emphysema, and by enlargement of the right ventricle, or it may extend upward above the nipple with a wavy appearance in dilatation of the left ventricle, and especially in pericardial effusion, while in extra-pericardial adhesions a remarkable alteration may be visible in a systolic retraction of the intercostal spaces and of the end of the sternum. Inspection then of the shape of the prærcordium may show a uniform enlargement in all directions in pericardial effusion, amounting to true bulging of the part, rarely, however, with obliteration and widening of the intercostal spaces. Bulging may also be observable in the bovine heart of aortic incompetence in young subjects, but is rare in other forms of hypertrophy

Palpation should be begun with one finger at the apex, and the finger should then be carefully passed over the whole cardiac area to find the first sign of a thrill. The detection of one is a valuable aid to diagnosis, as its relation to the movements of the heart is more readily made out by the sense of touch than the rhythm of a murmur is by the ear. Thus the apex-thrill of mitral stenosis is easily felt to precede and stop with the apex-beat. The point at which a thrill is most sensibly felt should

be carefully noted, and then in what direction it does or does not continue to be felt. The conclusions from such palpation are quite as certain as those which auscultation affords, and the signs may be found either with the systole or before it at the apex, with the same limits or tracks of conduction as the corresponding mitral murmurs, or with the systole or diastole at the base transmitted into the aorta or down the sternum as basic murmurs are. In some stages of pericarditis a friction fremitus is best felt by the hand laid on the part.

Palpation also conveys much information with reference to the heart-impulse. Though widely visible in pericardial effusion and in pronounced dilatation, it is much less appreciable by the hand in these states. The contrast then with the push of a strongly hypertrophied heart weighs much in the diagnosis of effusion or in the prognosis of dilatation. In advanced cases of aortic incompetence the apex-beat may seem double, but it is soon perceived that the second stroke occurs during the diastole, and is the jog of the regurgitant stream from the aorta impinging against the ventricular wall, where, after death, a network of reticulated tissue is found developed on the spot which received the impact. On the other hand, the absence of impulse, either visible to the eye or sensible to the touch, and associated with a weak pulse, may be the only physical signs for the diagnosis of muscular degeneration of the heart.

Percussion does not render as much service in the examination of the heart as in the case of the lungs. This is due to the smallness of the area of the heart, which is not covered by bone or by lung-tissue, and, further, because the left lobe of the liver below gives the same note on percussion as the heart itself. Only the positive percussion indications, therefore, can be accepted, for absence of increased area of percussion dulness does not prove by any means that hypertrophy or dilatation is not present. As Fagge remarks: "One may find at the autopsy of a case of cerebral hæmorrhage an enormously hypertrophied heart, notwithstanding that a few hours previously it may have been impossible to detect any clinical evidence of such a condition, the organ having buried itself within the hollow of the left lung, so as not to come more widely in contact with the chest-wall than in normal circumstances." Fraenzel also says: "Percussion of the heart permits no conclusion with regard to hypertrophy. In the normal individual, in the most favorable event, we obtain dulness at the upper border of the third rib at the left edge of the sternum, which extends downward occasionally to the lower border of the sixth rib. Externally, this dulness extends, at the most, to the left mammary line. Only occasionally can the lower border be distinguished from the hepatic dulness. But in the normal state of the heart even these limits are rarely reached in all directions. But if they are exceeded, while at the same time we can

exclude disease of the adjacent organs, then the increased area of dulness must be attributed to an affection of the heart itself. If the dulness is increased in all directions, there is probably an accumulation of fluid in the pericardial cavity: in enlargement of the right ventricle there is increased dulness in that direction, and downward and to the left in enlargement of the left ventricle."

The method of percussion, however, has much to do with the information obtained. Only very light percussion gives trustworthy results, and the stroke on the plexímeter finger should be made on the nail. Using the middle finger-nail for this purpose at a spot of marked dulness, the stroke can then be made for comparison on the nail of the ring finger, moved from and to the fixed middle finger. In this way the gradations of resonance can be easily appreciated. In most persons, however, with large, full chests, still more when the lungs are emphysematous, the heart is too much removed from the chest-wall to render percussion of much avail.

From the date of the discovery of auscultation physicians have grown accustomed to regard it as the great and chief means of diagnosis of disease of the heart, on account of the accuracy of its indications. So it still is, but it is a mistake to consider it as all-sufficient. Its signs may be quite misleading, as when typical murmurs exist during life in a case of simple distension of the left ventricle in Bright's disease, but in which the valves may be found, post-mortem, quite healthy. Leyden says that loud murmurs are of better prognosis than feeble ones, and often the worst cases are those where auscultation fails altogether. It is, moreover, of much importance that auscultatory signs should be observed in a systematic order, so as to note the easiest determined first and the most difficult last. Thus, to a beginner it may well be embarrassing to settle the rhythmic succession of the sounds which he hears. Instead of the 14 to 16 respiratory sounds a minute of pulmonary auscultation, he may have, in a case of combined endo- and pericarditis, 72 murmurs replacing the heart-sounds in the same time. When to this element of number irregularity of rhythm is added, it is plain that the relations of the sounds or murmurs to the systole and diastole respectively may be impossible to decide without previously obtaining the aid of the other elements in auscultation. The first observation to note, therefore, when a murmur is detected is the exact locality where it is heard plainest. If more murmurs than one are present, then where each of these is heard plainest should likewise be settled, for this often decides not only that there is more than one murmur, but what kind of murmur the first one noted is. The next step is thus made easier—viz. to determine in what directions the murmur is or is not transmitted. With these two points well determined, the question of rhythm then nearly settles itself.

Mitral murmurs have the apex for their region of greatest intensity. An apex-murmur which is conducted to the left, under the axilla, and is likewise plainly audible at the left of the spine about the second dorsal vertebra, while it grows less distinct toward the base of the heart, is, without doubt, a systolic regurgitant murmur. But an apex-murmur which is not transmitted in these directions, but grows less distinct toward the axilla and toward the base, is most likely the presystolic murmur of mitral stenosis. It might easily be mistaken for an aortic diastolic murmur, as this may be transmitted to the apex, and, moreover, both these murmurs occur during the diastolic period; but the seat of greatest intensity of the aortic diastolic is never at the apex, but down the sternum, or even at the base, and it is generally heard also in the aorta. The two mitral murmurs differ also, as a rule, from each other in other respects. The stenotic is rather harsh or grinding, but ends abruptly with a click, which marks the systolic closure of the valve, while the systolic murmur of mitral incompetence is soft, or at most blowing or booming, in its note. With both these murmurs the second heart-sound is heard only at the base, and it is there significant of the embarrassment of the pulmonary circulation to find the note of the semilunar valves of the pulmonary artery at the left of the sternum sharper than those of the aorta more to the right. In some cases of mitral stenosis, or even in emphysema, the pulmonary valves cannot close as soon as those of the aorta, and we have a reduplication of the second sound, best compared to the double rebound of a hammer after the first stroke on a hard surface. A mitral stenotic murmur often varies in intensity, being louder if the patient is sitting up than when lying down, or according to the rapidity of the heart-beat. Its frequent disappearance as the patient advances in age or in disease has been the subject of some fanciful explanations, but it seems most natural to refer it to a relative removal of stenosis by dilatation of the ventricle; for this often widens the mitral opening enough to produce incompetence, without the valves being even diseased. An aortic stenotic murmur is easily recognized by its site of greatest intensity being the base, and then by its transmission to the aorta at the second right costal cartilage, and thence up the carotids. It is then also plainly synchronous with the heart-beat. A diastolic aortic murmur has its point of greatest intensity just below the base of the heart at the mid-sternum, and is transmitted either directly down the sternum or a little to the left. It is also transmitted into the aorta, but, of course, not so plainly as the systolic murmur. Its rhythm is more easily made out than the diastolic murmur of mitral stenosis, for it begins immediately after the systole ends, and occupies the whole diastolic period. When a double aortic murmur is found, the louder the first or systolic sound is of the two, the better the prognosis, although

if the diastolic murmur be prolonged it does not show so much disease as when it is very short, for this may mean that the blood is falling back into the ventricle with great facility.

Auscultation should also take note of simple modifications of the natural sounds. A weak first sound at the apex, with a too clear second sound at the base, is one of the signs of failing heart, as in fevers, the first sound being feeble because the ventricle is contracting feebly, while its quick relaxation causes the semilunar valves to flap back suddenly with a short snap. If only one sound is heard in fevers, it is the second sound. On the other hand, these signs are closely imitated in the cardiac hypertrophy of Bright's disease or in general arterial sclerosis. The difference is that the first sound in hypertrophy is muffled and prolonged, owing to the long stroke of the ventricle in forcing the blood into the over-full arterial system, while the short, sharp second sound is caused by the strong recoil of the distended aorta. The difference is further made more evident by the complete contrast between the impulse of the apex-beat and the opposite qualities of the pulse in the respective states.

Murmurs at the valvular orifices ef the right heart are infrequent, and, with the exception of tricuspid regurgitation, are commonly congenital. Dr. Bradford Fenwick has collected 70 cases of stenosis of the tricuspid, with presystolic murmur, the majority of which were in young women who also suffered from mitral stenosis. The murmur was heard best over the fifth right costal cartilage, near the sternum. Tricuspid regurgitant murmurs are of a soft character, heard best at the right of the ensiform cartilage, but are always difficult to distinguish from coexistent mitral regurgitant murmurs. Pulmonary systolic murmurs have their point of greatest intensity at the base, close to the left edge of the sternum, and transmit toward the left clavicle. Venous murmurs, on the other hand, are quite frequent. In tricuspid regurgitation, with venous pulse, a systolic murmur may be heard at the origin of the descending vena cava in the neck. But much the most pronounced of the venous murmurs is the loud, continuous hum heard oftenest in anæmic young women, when the stethoscope is laid lightly on the jugulars just above the inner end of the clavicle. That it is in the veins is shown by its immediate arrest by pressing with the finger upon the vein above. In some anæmic patients systolic basic murmurs, transmitted into both the aorta and the pulmonary artery, are also sometimes heard. The various explanations of the genesis of these anæmic murmurs are too numerous to discuss, but their functional character is shown by their simultaneous disappearance with the anæmia.

An examination of a case of heart disease cannot be considered complete without a careful comparison of its indications with the state

of the arterial flow. The sphygmograph supplies a very satisfactory schematic representation of the relation of the action and states of the heart to the vibrations of the blood throughout the arteries, whether in health or disease, but its uses are not so much clinical as explanatory and confirmatory of the indications which manual examination of the pulse affords. The practising physician had much better rely on his sense of touch, which can be trained to note the conditions of the blood-current with a delicacy and certainty which no mechanical contrivance can match. But as in physical examination of the lungs palpation and percussion should precede auscultation, so a physical examination of the blood-vessel itself should precede that of the characters of its pulse-beat. To do this three fingers should be laid on the radial at the flexed wrist, and the vessel carefully palpated transversely and up and down its course. If the artery is in a normal condition, it cannot be felt as it lies in its sheath except by its beat. It may be felt instead as a smooth resistant cord or as a rough, hard, and crooked tube for some distance up the arm. In the first case, it may be only over full from obstruction to the outflow in the arterioles or capillaries. In the second case, it is not only over full, but its coats have become diseased and thickened with atheromatous patches, which in some patients give it the feeling of a string of beads. To determine whether it is simply a distended artery or a thickened one, the upper finger should then be pressed upon it, so as to stop the blood-current within, when, if it be only over full, the other two fingers no longer feel it as before, but if it is permanently thickened it is still perceptible as a hardened cord. The conclusions which this examination allows are not only of importance in cases of heart disease, but of many general conditions of the circulation as well, sufficient to affect the prognosis of a pneumonia or to suggest liability to hemiplegia. A diseased radial implies a general arterial degeneration, with extensive obliteration of arterioles. The skin in such a state of the circulation must be everywhere relatively anæmic, which it shows by its slowness to redden on friction; and, as the veins cannot receive the normal impulse of the heart through such an intermediate obstruction, the tendency to œdema on the supervention of an inflammatory congestion, as in pneumonia, is much increased. But it is on the work of the heart itself that the onus of the change is first and most felt, and besides this very probably in its nutrition, from disease of the coronary arteries on the one hand, and from extension of the same changes in the intima of the aorta to the semilunar valves.

The characters of the pulse may now be studied according to the six elements which enter into a pulse-beat. The first three depend upon the action of the heart; viz. its frequency, force, and rhythm —that is, whether the pulse be slow or rapid, strong or weak, regular

or irregular—while the other three depend upon the state of the vessel—namely (1) the size of the pulse, whether large or small; (2) its quality, whether it be compressible or incompressible; and (3) its length, whether the pulse-wave take a relatively long or very short time to pass under the finger. A seventh character of the pulse of a pathological kind may be added, the dicrotic, which in debilitated conditions, as in fever, is manifested by a reflux wave in the relaxed blood-vessel after the passage of the true pulse-wave.

The relation of the pulse to various valvular disorders has been already alluded to, but there is one pulse-character which merits a special mention on account of its bearing on the etiology of chronic heart disease; and that is the incompressible or high-tension pulse. It is very easily mistaken for a strong pulse, because the continued throb of the vessel after considerable pressure is exerted upon it gives the impression of a strength sufficient to force its way against obstructions, whereas, if the heart, the source of pulse-strength, be examined, it may be found quite weak. An incompressible pulse is solely due to obstruction in the outflow, just as one can stand on a hose if the stop-cock closes the water from escape. In an artery the outflow may be hindered by reflex nervous spasm of the arterioles, as in the hard pulse of peritonitis, or from irritant blood-ingredients, as in the hard pulse of gout, or from this with endocarditis added, as in chronic Bright's disease; and the general condition which leads to a continued high-tension pulse must necessarily, in time, lead to left-ventricle hypertrophy as the first in a long series of consecutive cardiac derangements. An incompressible pulse is also a long pulse, for the pulse-vibration is short only when there is no resistance to the flow.

Chronic Secondary Heart Disease.

The clinical history of many cases of chronic cardiac disease is that one who has never suffered from any form of heart affection before begins after he is forty-five years old to notice that he easily gets out of breath on going up stairs. In time this happens on comparatively slight muscular exertion, especially after eating. He concludes that he is bilious, because dyspeptic symptoms, with some sallowness, make their appearance; but finally some swelling of the feet alarms him enough to consult a physician. On examination his radial artery can be felt and rolled like a cord in its bed, while his pulse is long and of high tension. Auscultation of his lungs gives jarring expiration, with mucous râles at both bases. The action of the heart is labored—that is, the systole is long with a muffled first sound, and the impulse strong and diffused—while the second sound at the base is clearer than natural at both edges of the sternum; but besides an occasional irregular or intermittent beat there is no murmur or other sign of

heart disease. The urine is found to be abundant, pale, of low specific gravity, and occasionally with a little albumin and a few casts. Under proper treatment he gets better for a time, his breathing becomes easier, and all signs of œdema disappear. But after a while the same symptoms return, and he begins to have suffocative attacks at night, with more or less expectoration; his strength fails, his digestion is more impaired, albumin appears oftener in the urine, and the dropsy of the legs increases, till anasarca and pleuritic effusion, particularly on the left side, progressively develop. Auscultation of the heart still fails to detect a murmur, but, instead, the rhythm of the heart becomes very irregular, and a discrepancy develops between the number of the beats of the heart and those of the pulse at the radial, the latter being much fewer. The dropsy continues to increase along with the embarrassment of the breathing, until death supervenes. The heart is found, post-mortem, with the left ventricle greatly hypertrophied and the right less so, but the valves seem to be all right. If the ventricle, however, be stretched by the fingers to reproduce its state in life, which has been lessened by post-mortem contraction, it becomes plain that it was then so dilated that both the mitral and the sigmoid valves must have been more or less incompetent. Some writers term a case like this "idiopathic enlargement of the heart." We might as well say that the patient spontaneously died. The findings after death show, instead, that for a long time the left ventricle had a hard task to perform, and which for an unknown period it did perform so well, because it grew for the purpose, that the patient was not aware that anything was wrong. It was not until it began to be labor-worn, and, losing its tone, began to dilate, that he noticed his breathing growing short. The real, primary cause of the heart affection, therefore, was the condition which gave such high tension to the pulse.

A ready explanation, which has been widely received, of the arterial tension which leads to cardiac enlargement, is that it is due to general endarteritis. When one considers the extent to which the lumen of the arteries must be diminished, especially in the smaller branches, by the sclerotic and atheromatous changes which are often found so generally disseminated that immense numbers of the arterioles must virtually be closed by them, it seems as if the obstacle in the circulation to be overcome by the left ventricle must be equal to anything which a diseased valve could occasion, for no aortic stenosis could be more effective than such a general stenosis. But, unfortunately, some autopsies disprove the sufficiency of this hypothesis in both ways, for cases of general sclerotic and atheromatous arterial disease have been found without any cardiac enlargement accompanying them, and cardiac enlargements, on the other hand, have been as often found without any arterial changes. The cardiac enlargements, however, always had

high-tension pulse in the clinical history, whether the arteries were diseased or not. On this account, Traube, who at first advocated the endarteritis theory, gave it up, and, instead of regarding the heart disease as caused by the arterial disease, regarded them together as due to a more general cause. Fränzel suggests that some unknown ptomaïne in the blood may be the primary cause of the high tension, and this, in turn, may be the occasion both of the endarteritis and of the heart disease. Without further discussing these theories, it is worthy of remark that in chlorosis we have a high-tension pulse, and, very often, cardiac hypertrophy, which disappears when the chlorosis is cured. Why cannot the circulatory difficulty in this case be in the capillary circulation, on account of the interference with the interchange between the capillary and the extra-capillary or interstitial circulation, due to the oxygen of the blood being altered? The extra-capillary circulation is, for nutrition, the most important department of the whole circulation; and that this may be itself the seat of the circulatory embarrassment on account of changes in the blood is rendered very probable by all that is known of the condition of the blood in cases of high-tension pulse, such as in gout, lead-poisoning, and renal disease. These are each conditions of blood-poisoning which can easily be conceived of as primarily deranging the osmotic function which capillaries subserve; which, it should be remembered, is not merely to conduct the blood, as the larger vessels do, but to exchange inflow for outflow with the interstitial current. This was the original hypothesis of Bright himself, to account for the frequent coincidence of heart disease with kidney disease, and I do not see that any subsequent theories have improved upon it. Muscular tissue is present in tubular structures only to move something out of them, and the increased tonus of the arterioles means that there is obstruction—not in them, but in the capillaries beyond; and a general blood-contamination disturbing capillary osmosis will therefore raise the whole arterial tension, with the effect of increased heart-labor, without arterial disease necessary anywhere. This blood-contamination, however, is very prone to set up inflammation in the intima, not only of the arteries, but, as has been shown by Arthur V. Meigs, in the veins as well, so that, doubtless, arterio-sclerosis, while not sufficient to account for all cases of these forms of secondary heart disease, yet is a serious complication of the original cause of the cardiac affection.

High-tension pulse is found in every form of structural kidney disease, invariably in the contracted kidney, less invariably in the large white kidney, still less in waxy degeneration and in pyelo-nephritis; and consecutive heart-change is present in the same ratio in these different renal affections. But in addition to the arterial obstruction the toxæmia of Bright's disease is often a direct cause of endocarditis, some-

times of pericarditis as well, so that the usual ante-mortem symptoms and post-mortem findings of valvular disease, already described, are the rule in these cases. Besides developed kidney disease, persons with the uric-acid diathesis are prone to become short-breathed and to suffer general arterial change from an accumulation in the blood of imperfectly oxidized products of retrograde metamorphoses. Over-indulgence in eating, and still more in drinking fermented liquors, whether wines or beers, with sedentary habits favoring portal stasis, may develop all the train of the results of cardiac dilatation on the supervention of some extra-cardiac strain, as a bronchitis, or after some cause of general enfeeblement. With many others the tendency to heart disease, from the same circulatory conditions, is as plainly hereditary as a tendency to apoplexy. In Bright's disease the hypertrophied left ventricle often fails in power before the hypertrophied right ventricle does, with the result that the latter may overwhelm the lungs with more blood than the weakened left can dispose of. Attacks of a suffocative asthmatic kind, with profuse expectoration of blood-streaked mucus, may occur, or a more chronic condition of combined cardiac and respiratory dyspnœa from pulmonary œdema continue with great aggravation of the patient's distress. At other times Cheyne-Stokes' respiration may develop, when it is of worse prognosis than in most other conditions in which it is observed.

Heart Disease from Bodily Strain.

Badly-fed and under-nourished laborers, whose occupation entails carrying heavy loads up ascents, are prone to suffer from dilatation of the heart, coming on gradually without valvular disease, but ending in much the same way as the forms secondary to vascular disorder just described. To lift a heavy weight a deep inspiration is first taken, and then the expiration is suddenly stopped. The extensive muscular contraction which then follows while the breath is held forcibly empties the veins into the heart. It is easy to see that both ventricles must suffer distension from such an access of blood coinciding with an interruption of the respiratory rhythm, and, if the general muscular nutrition is weakened by insufficient food and unhealthy drink, a constant repetition of such acts will naturally lead to dilatation of the heart. Occasionally cases occur in which acute distension of the left ventricle results from some one act of over-strain, as in a hospital patient of mine, a young, athletic ice-man, when attempting to throw a large block of ice along a sidewalk. He was seized with an intense pain in the cardiac region, which radiated down the left arm, and he fell breathless to the ground. On admission he was scarcely able to speak, he had a constant short cough, and was deeply cyanosed; the percussion dulness extended half an inch outside of the nipple line, and a

diastolic murmur was present. In three days these physical signs had so diminished, and the patient felt so well, that he could not be persuaded to stay in the hospital, but left to resume his work. This was a dangerous proceeding for him, as the rule is that acute strain, unless time enough is allowed for recovery, sets up a chronic irritability of the heart which ends in incurable dilatation.

It is often asked of physicians whether athletic exercises, such as boat-races, football games, etc., so popular now with young collegians, do not entail risk of heart disease. There is no doubt that the severe preparatory training which many of them take would be dangerous to certain constitutions, for the profession has been made familiar with the results of such muscular strain by the treatises of DaCosta in this country and of English and German writers on the irritable heart of young soldiers, which is induced by prolonged drill and marching with too confining or heavy accoutrements. After a slight attack of diarrhœa or fever, the soldier on returning to duty soon finds that he suffers with palpitation or faintness, and he is returned to hospital with pronounced and obstinate disturbance of the heart's action, such as dyspnœa and rapid pulse, much increased by standing, and with failure of circulation in the extremities. If this state be not remedied by prolonged rest and proper treatment, what seemed at first to be but a functional derangement ends in permanent organic heart-damage, both valvular and muscular.

Muscular Degeneration of the Heart without Dilatation.

We prefer this term to "fatty" degeneration, because the group of symptoms which belong to the affection indicate a heart weakened by a muscular degeneration which may be fatty, and also may not be fatty, but something else. A patient just recovering from typhoid fever rises too quickly in bed, and thus induces fatal syncope. His heart is found, at autopsy, to be of a paler color than natural and of a soft and brittle texture, but the microscope shows nothing that resembles the real fatty degeneration of heart-muscle found in phosphorus-poisoning or in pernicious anæmia. So, in practice, we have patients who show symptoms of essential cardiac debility—breathlessness on exertion, cold extremities, weak but compressible pulse, and with no visible or sensible apex-beat, while auscultation reveals no murmurs, but only a weak and short first sound, with much the character of the normal second sound. Chronic symptoms of heart failure, such as flatulence, diarrhœa, dropsy, and orthopnœa, may successively develop, and yet the patient recover and enjoy good health for several years, and then die suddenly, as a patient of mine did whose father and brother had died in the same way. Another patient had quite recovered for two years from similar symptoms, but succumbed in a week

from acute dilatation of the heart brought on by a night's detention on the cars in New Mexico at an elevation of about seven thousand feet. The weakness in the heart-walls, which is the disease of these patients, has, however, different anatomical characters in different cases. In some there is a partial but marked fatty degeneration, associated with a diseased coronary artery. In others the fatty change is sufficient to be visible to the naked eye as fine yellow points or streaks crossed with darker striæ, especially in the papillary muscles. But it is after such acute affections as phosphorus-poisoning or myocarditis in diphtheria, or in severe chronic anæmias, as pernicious anæmia, that such typical forms are found; instead, therefore, of being an independent disease in them, it is a sequel to other morbid processes. On the other hand, cardiac muscular weakness, proceeding to a fatal issue, sometimes sudden, occurs as a constitutional affection in persons frequently with a neurotic family history, in whom no more appreciable fibrillar change can be found in the flabby heart-muscle than in some cases of fatal angina pectoris. In the autopsies of corpulent persons who have died with symptoms of heart failure deposits of fat are often found, under as well as over the pericardium, in such quantity as to suggest the hypothesis of invasion of the heart-muscle by fat as a distinct morbid state. This, however, is doubtful, as the heart disease is oftener explained by vascular and valvular disease being also present. There can be no doubt, however, that obesity, *per se*, is unfavorable to healthy cardiac tone by its interference with free respiration, and by its fostering the sedentary habits which weaken muscular structures in general.

Fibroid Degeneration.

This is a special morbid condition characterized by the presence of masses of hard white cicatricial tissue, found in the heart-walls, almost always of the left side. They can scarcely be said to be the results of endo- or pericarditis, for they may be imbedded in the muscular walls without either the endocardium or pericardium showing any connection with them. Sometimes they are so related to the endocardial surface as to suggest their origin from a circumscribed abscess arising, as already explained, in an acute endocarditis; at other times they appear on the outer surface as white patches, to which the pericardium is adherent, or they appear as numerous streaks of connective tissue distributed irregularly through the muscular substance. That they do not constitute a true fibroid degeneration of the muscular tissue itself, however, is evident from the normal state of the fibres themselves; and it is now determined that they are caused by obliteration of atheromatous branches of the coronary arteries by thrombosis, and consequent degeneration of the parts supplied by them, with the usual substitution, in time, of cicatricial tissue. Syphilitic disease of the coronary arteries is also

probably a frequent cause of the affection. The action of the heart may be much impeded by these tough structural changes in its walls, which occasionally produce such a local thinning of the ventricular parietes that pouch-like cavities, or so-called aneurisms of the heart, are formed.

As might be expected, auscultation can afford but little help in the diagnosis of this condition, as there are rarely any valvular signs. The symptoms are those of chronic circulatory embarrassment simply; the pulse is generally slow and intermittent, and the patient is very apt to sigh frequently. He is generally very despondent, from a sense of constant oppression in the chest, especially on exertion, and from general muscular debility. He may continue thus an invalid for years, and die finally with the usual developments of circulatory failure; or else he may expire very suddenly, as animals do in whom a large branch of one coronary artery has been tied, when for some time the beats seem to be but little affected by the operation, and then come to a sudden stop.

Extra-Pericardial Adhesions.

While the sequelæ of simple acute pericarditis, as previously stated, are not as serious as those of endocarditis, the same cannot be said if the inflammation involves the adjacent parts. If this occurs, the heart may become permanently fettered to the chest-walls, or to the mediastinal layers of the pleura, or to the diaphragm, or to the structures of the posterior mediastinum, with the most distressing after-effects, for the benign influence of hypertrophy, which counteracts obstructions for so long in other cardiac affections, is here, to a great extent, prevented by the irregularity of the heart-strains present and by their external seat. Primary dilatation of the cavities on both sides very commonly results, with cardiac pains and severe distress in breathing, general marasmus, and dropsy. When the adhesions with the pleura are extensive, we may have the *pulsus parodoxus*, so named because the heart-beats are affected by the movements of respiration. A left pleurisy or pneumonia, simultaneous with a pericarditis, is therefore of evil augury, and no effort should be spared to check their mutual interaction.

Treatment of Chronic Heart Disease.

The treatment of chronic heart disease should be clearly separated into the measures which are palliative and those which are curative in their nature. We may fail equally with either, but that does not affect the difference in the objects sought for in the employment of the two classes respectively. Thus, under the class of palliatives come all the nervines which are prescribed in the treatment

of organic diseases of the heart, such as digitalis, strophanthus, strychnine, caffeine, etc. Neurotics never affect structures, but only functions. The organic changes remain just the same as ever, no matter how long the remedies are administered, and all that should be expected of a nervine is that it relieves some symptoms of the morbid condition, but not the condition itself. This is according to the therapeutic law, to which there are no exceptions, that any drug whose specific medicinal effects can be secured by one dose cannot modify or affect a structural change. We refer to these principles of therapeutics here because there seems to be such a widespread reliance on drugs in the treatment of organic lesions of the heart, any one of which might be taken as long as is that powerful cardiac nervine, tobacco, without the most skilful microscopist being able to detect its effect on the heart-structure. In many cases of cardiac dilatation digitalis affords as much relief as stramonium does in many cases of asthma, but the hundredth dose of stramonium does not do more than the first did; that is, relieve the symptom, bronchial spasm, for the disease, asthma, remains as settled as ever. Nor can any other nervine do more than digitalis does with each dose for a certain number of hours—viz. stimulate the contractile function of the heart-muscle, the heart-muscle reverting to its old state as soon as the functional effect of the symptom-medicine has passed off. Therapeutically, therefore, all such remedies can be regarded only as temporary makeshifts, with the chances that ere long they will begin to fail and become less and less effective. The beneficial effects of digitalis are due to the cramp-like contraction which it induces in the heart, as it does in the other hollow organ, the uterus. It therefore lessens dilatation by interfering with the over-relaxation of the diastolic period. For the time, therefore, the heart has returned to its natural cavity-dimensions, with great consequent relief to all the distressful accompaniments of a heart which does not empty itself with each stroke. It is therefore not as serviceable when the diseased heart does empty itself with each systole as in the first stages of aortic regurgitation, when it has not yet dilated beyond compensation. The effect of digitalis on the pulse in a case of dilatation is often very striking, by its substituting slow regularity for the many ineffective contractions of the over-distended ventricle; and with such a recovery in the circulation we may expect the breathing to improve with the restoration of the cardio-respiratory rhythm, and with the chance thus given for the pulmonary œdema to be taken up. The hepatic stasis and the gastric congestion may be expected to improve next, and finally the kidneys will return to better work. The patient seems to improve in every respect, and hence this drug is often spoken of in terms which imply that it is *the* remedy for organic heart disease. It is an excellent adjuvant, but, like all nervines, it can be nothing more.

There is one disadvantage, however, in the action of digitalis, and that is that it acts on the muscular coat of the arterioles as it does on the ventricle, and thus raises the tension of the pulse. In many cases, therefore, we lose as much by contracting the already too-much-narrowed arteries as we gain on the heart by contracting it. This is particularly exemplified by the aggravation which digitalis occasions in the cerebral symptoms of Bright's disease.

We have one nervine, however, which can both counteract this undesirable vascular effect of digitalis, and at the same time promote its action on the heart, illustrating the frequent advantage of combining nervines which act alike on some nervous functions, but differently on others. That agent is nitro-glycerin, which promptly dilates the arterioles, while it stimulates the cardiac systole and for several years I have been accustomed, on this account, to administer it simultaneously with digitalis, as well as with other so-called heart tonics, with a great improvement in the effects.

Of the preparations of digitalis, the infusion of the leaves is undoubtedly the best in heart dilatation, in doses of 1 to 2 drachms every three or four hours. A reliable tincture comes next in value, in doses of 10 drops, but the fluid extract is the least certain in its effects—in heart affections, at any rate. The nitro-glycerin should be administered only in a recently-made solution, $\frac{1}{4}$ grain to 3 ounces of water, a tea-spoonful of which contains $\frac{1}{96}$ of a grain. The small manufactured nitro-glycerin pills supplied to druggists are often untrustworthy. The dose should be that which shortly after administration gives a slight sense of fulness in the temples. The difference in susceptibility among patients to this drug is remarkable, some being able to take $\frac{1}{25}$ grain without feeling it, while others complain of headache from $\frac{1}{200}$ grain.

Along with digitalis, strychnine or the tincture of nux vomica is another excellent adjuvant. I prefer the tincture, and give it in 10-drop doses with the digitalis and the nitro-glycerin. The administration of these three drugs can be kept up without change for an indefinite period with some patients, just as some asthmatics can take their favorite prescriptions for months, but with most patients digitalis after a time disturbs the stomach, and we are obliged to intermit its use.

The tincture of strophanthus, in doses of from 5 to 10 drops, is, according to my experience, a good substitute for digitalis, and I often prescribe it along with digitalis itself, as well as with the other neurotics mentioned. It is particularly adapted to all cases of palpitation, whether functional as in Graves' disease or when complicating organic affections. It does not equal digitalis in the treatment of dilatation, for it does not interfere with the diastole, but it is almost free from

the contracting effect of digitalis on the arterioles. One drawback is the uncertainty of its preparations, which sometimes vary greatly in their properties. Some two years ago the tinctures supplied to the New York market were noted for causing diarrhœa.

A very valuable heart-stimulant also is caffeine, in doses of from 1 to 4 grains of the citrate. It seems specially adapted for the dyspnœa of mitral stenosis, and, with nux vomica, is better than digitalis in aortic incompetence.

My experience with convallaria majalis, sparteine, and barium chloride has been tolerably extensive experimentally, but with such uncertain results that I can rank them only with those remedies which may be tried haphazard when one does not know what else to give, for, like all other neurotics except colchicum, they cannot do any permanent mischief.

In many cases of beginning arterio-sclerosis, with high-tension pulse, we have a serious symptom of developing mischief in a quickening of the pulse. These patients naturally complain of head-symptoms, and may come for the first time for advice on account of such troubles as vertigo, etc. The rapid pulse implies subacute endocarditis, and then aconite, with small doses of corrosive sublimate, $\frac{1}{30}$–$\frac{1}{24}$ of a grain, should be administered, with the constitutional treatment to be soon mentioned.

In contrast with this symptomatic treatment of chronic diseases of the heart the physician should study how their structural changes can be prevented or averted. This can be done only by reversing their processes of development according to the physiological laws which their development shows to have been contravened. Thus, the heart as a muscular organ depends for its vigor, as all muscles do, on the activity of the respiration. It is a universal law throughout the animal kingdom that muscular power is directly proportioned to the amount of oxygen consumed. This is why insects, who can breathe from nearly every part of their bodies, are so exceptional in muscular strength. The recent discovery that muscles have in addition to, and independent of, their contractile function, the function of generating animal heat is one of great significance in establishing the prime necessity of the oxygen-supply to them. The blood coming from a large muscle, such as the gluteus when at perfect rest, is nevertheless more venous in its diminished oxygen and increased carbonic acid than the blood of the right ventricle, because the latter contains visceral venous blood also, and glands, even when most active, do not abstract as much oxygen from the blood as muscles do when apparently most inactive. The application of these principles to a case of threatened weakening of the heart-walls is obvious. Such a patient demands the freest respiration which can be secured for him, and which will be in as complete

contrast with his bodily habits in the past as possible. It is from that point of view alone that I regard Oertel's treatment of heart diseases as capable of doing good. The other features of the system, of enjoining active muscular exercise, such as mountain-climbing, etc., are applicable only to a minority of cases, and require the greatest discrimination in their employment, for the ratio between allowable work and overwork varies so much in different cases that I prefer safer methods for attaining the same results.

An ideal environment for a patient with organic heart disease would be a comfortably furnished shed-shaped tent, with good ventilators at each end and with a board floor well raised from the ground. Tents with all the requisite facilities for camping can be obtained in this country now, and with a little experience a camp-life can be made more comfortable, enjoyable, and less expensive than living at any Adirondack hotel, with the great object secured of really constant free breathing; for no dwelling apartment can give the same air at night which the patient receives through the tent-walls, as it is continuously changed through them without a draught. The most noticeable effect of two or three months of camp-life is in the lowered arterial tension, which may be noted even in the worst cases of arterio-sclerosis. The restoration of visceral muscular power is also illustrated in many other ways. I have known obstinate constipation of years' standing thus spontaneously relieved, the residual urine in elderly patients with distended bladders greatly reduced (in one case a man of seventy-four was quite cured), and chronic bronchitis progressively improve, with no other agency to account for these results than simple free breathing, with but very moderate muscular exercise. When camping cannot be resorted to, the next most continuous mode of open-air life must be devised, and the patient be enjoined to spend as little time indoors as possible, the details for securing this end being those which circumstances will permit.

It is on this principle that iron is the medicine for organic heart disease, not only as a standard remedy, but as a prophylactic against muscular degeneration. Iron has only one object in the animal economy. Without it we could not breathe. To keep up the due proportion of this oxygen-carrier in the blood is therefore the great indication whenever a form of muscular weakness is likely to develop, whether in the bronchial tubes, the alimentary canal, the pelvic organs, or, lastly, in the circulatory system. Every case of organic heart disease or vascular disease therefore indicates the use of iron, if only to keep hypertrophied muscles from losing their contractile power. The prompt improvement caused by iron in such a variety of disorders of weakened tubular organs is not because it cures "anæmia," but because it revivifies their muscular walls with an increased supply of oxygen.

In primary chronic valvular disease open-air life and iron, taken from time to time as a prophylactic, will serve indefinitely to ward off the day of heart failure. With the rheumatic cases, however, we must be on the constant watch for relapses of the rheumatism, and consequent further heart mischief. As the left ventricle often hypertrophies rapidly in young persons with aortic lesions, while the right does not, pains in the cardiac region and palpitation are prone to develop from derangement of rhythm between the two sides. For this belladonna is the best sedative, in 10-drop doses of the tincture, with 4 or 5 grains of potassium iodide three times a day, and the patient should wear a belladonna plaster. Cod-liver oil is of great service in many cases also. Its first use in medicine, to which it was restricted for over a century, was in the treatment of rheumatism, and for the anæmia of protracted cases of the subacute articular form it is superior to any other remedy. During cool or winter weather these patients should wear as a preventive buckskin shirts over light flannel underwear, and they should sleep in flannel. It is always risky for rheumatics to indulge in cold-water bathing, but the ancient practice of daily skin inunctions is one of the best of prescriptions for them against fresh attacks.

In chronic secondary valvular disease we have to take into account the constitutional state which has caused the heart affection. In the high-tension pulse of gouty and lithæmic patients a steady course of lithia-water is to be prescribed. The Buffalo lithia-water is rather too weak in lithia, but I have known a year's course of it improve the short breath of some patients very strikingly. The Londonderry Spring of New Hampshire has the highest percentage of this salt of any spring in this country, and five to six goblets of it a day, taken in lieu of ordinary water, may be prescribed. In many cases the French Contrexeville Pavilion Spring water, a goblet with each meal and at night, has been beneficial, especially where the gouty symptoms were pronounced.

The heart complications of Bright's disease have to be treated in connection with the kidney affection. Where the urine is pale and of low specific gravity, with a moderate deposit of albumin, corrosive sublimate, taken for a week at a time, $\frac{1}{24}$ of a grain three times daily, and then omitted for a week, has, in my experience, repeatedly improved the color and specific gravity of the urine, and has lowered the arterial tension. The important adjuvant action of nitro-glycerin has been already alluded to. It is in these patients also that the beneficial effects of frequent warm, but not hot, baths in relaxing arterial tension is manifested.

In the renal cases, of whatever form, the importance of regulating the diet cannot be over-estimated. In view of the recent advance in

our knowledge of the relations of intestinal digestion, and the rôle which auto-infection from intestinal poisons plays in the genesis of vascular and kidney disorders, the indications for supplying the most easily assimilable food, with the least excess possible of too concentrated nitrogenous ingredients, in kidney disorders, are more than ever confirmed.

No case of high-tension pulse, with consecutive heart complication, should take a hearty meat diet. The best food for such patients is the fermented milk of the Arabs. All pastoral peoples, who have to live exclusively on milk, as most Bedouins and Tartars do, have found that the stomach must be spared the curdling of the milk, else enough gastric juice is not left to complete the digestion of the precipitated casein; which, moreover, if precipitated in the stomach, is apt to be in too large and solid curds. They therefore artificially ferment the milk with the yeast-plant. The Arab method is preferable for invalids to the kumyss of the Tartars, as this is apt to be too acid from keeping. The "leben" of the Arabs or "matzoon" of the Turks is made daily by adding some of the fermented milk of the previous day to the fresh milk as soon as it is brought in from the milking. The "leben" the next morning is a slightly acid fluid of the consistence of cream, with small flaky curds and with the taste of buttermilk. I regard it as the completest and most digestible food for invalids that can be furnished, and the most striking illustration of its adaptability is to be found in severe organic diseases of the stomach with intractable vomiting, as in gastric ulcers or cancer of the stomach. In Bright's disease it has seemed to me often curative, and at least as near the typical food for giving the diseased kidneys the minimum of work as can be devised. The more the patients take of it to the exclusion of other food, the better, and to accustom them to its use they may begin with a half pint taken as a first course with each meal. It should always be *eaten* with a spoon like soup, and not drank. After a time larger and larger quantities will be readily disposed of. The directions for making it are: to break up by thorough stirring half an ordinary yeast-cake in half a pint of good fresh milk which has been warmed to a blood heat. This should then be kept for eight to ten hours in the kitchen, with occasional stirring, at the end of which time the milk will be found to have soured. Six tablespoonfuls, or 3 ounces, of this soured milk should then be stirred into a half pint of fresh milk, and the first half pint with the yeast thrown away. The second specimen will ferment in the same time as the first one did, but cannot yet be eaten on account of the still perceptible bitter taste of yeast; but 3 ounces of it can be used for a third specimen. In the fourth specimen the taste of yeast is no longer perceptible, and then the leben can always be made for each day's use in the proportion

of 6 ounces of the leben of the previous day to a pint of new milk. It is better to stir it well as soon as the milk is found to be changed, and then put in a refrigerator to prevent further acidification. Sometimes, after a month or two months, the yeast ferment seems to die out, and the process has to be begun again as above detailed. If it seems to make too large curds, it need then only be stirred well before eating it. The richer the milk in cream, the better and smoother the leben. With this milk and a digestible vegetable diet (excluding beans, asparagus, and fibrous vegetables, as turnips, beets, etc.), and a good supply of ripe fruit, especially grapes, the tension of the pulse may be found soon much less than when meat and fermented liquors have been largely used.

The management of certain acute complications remains now to be briefly spoken of. In all cases of labored heart-action a daily evacuation of the bowels is very necessary, for constipation quickly raises the tension of the abdominal arteries, and thus increases the heart's work. One tea-spoonful of Epsom salts, with a grain of quinine, in a tumbler of water on rising, may be prescribed as in most cases a sufficient laxative. In others a tea-spoonful of the compound liquorice powder, with a tea-spoonful of cream of tartar at night, while in still others one-fourth or half a tumbler of Hunyadi water in the same amount of boiling water in the morning, is best. All highly carbonated waters are ill borne by patients with heart disease, and the hot water is a good addition to prevent or get rid of the flatus which remains after most mineral-water purgatives have acted.

In advanced cases of heart disease we are often obliged to have recourse to opium to secure sleep. The rhythm of lung- and heart-action needed for sleep will not come without it. It is a hard alternative to meet, for the ultimate effect of the drug is undesirable, and its administration should be postponed until it is plain that the patient will be more weakened by his sleeplessness without it than by his depression with it. Any other soporific is useless, particularly chloral, but the aromatic spirit of ammonia may be very advantageously added to morphine when the alkaloid is given.

The attacks of asthmatic suffocative congestion of the lungs in renal disease with cardiac dilatation require prompt and active treatment. The aim should be to rouse the weakened left ventricle to action, and for this purpose a hypodermic injection of $\frac{1}{8}$ grain of morphine with $\frac{1}{120}$ grain of atropine should be given, and simultaneously by the mouth a tea-spoonful of aromatic spirit of ammonia with 3 tea-spoonfuls of the elixir of valerianate of ammonia in water. Dry cupping over the kidneys and back of the lungs should then follow, with the application of a large blister to the front of the chest, which should be allowed to stay on long enough to redden the skin, but not to pro-

duce vesication. As soon as the dyspnœa and the expectoration show symptoms of subsiding, a brisk cathartic of 40 to 60 grains of compound jalap-powder, with 5 grains of calomel, should be given, or 1 to 2 drops of castor oil. Fränzel recommends 1 grain of acetate of lead to be given every hour while the urgent symptoms continue.

In the ascites of dilated heart from extra-pericardial adhesions I have seen more good follow tapping than in abdominal dropsy from any other cause. The severe distress of the patient is often remarkably relieved, for it would seem as if abdominal distension produced a special strain in these patients on the adhesions to the ribs and to the lower sternum. One measure, however, should never be neglected in these patients, and that is to strap firmly the ribs of the left side with adhesive plaster up to the axillary line. The strips should extend from the spine to the median line, following the direction of the ribs, and in applying them pressure should be made along the lower, and not the upper, border of the strip, to have it fit evenly, each succeeding strip also overlapping half the width of the one previously applied. The great relief which this uniform restriction of the movements of respiration over the heart affords is immediately appreciated by the sufferer. From time to time the strips have to be left off on account of irritation of the skin caused by the plaster, and during the interval the whole præcordium should be rubbed with an ointment composed of unguentum stramonii, unguentum hydrargyri, of each ʒij, oleum cinnamomi gtt. ij, in hopes of assisting in the absorption of the adhesions.

NERVOUS DISEASES OF THE HEART.

By T. LAUDER BRUNTON, M. D., D. SC. EDIN., LL.D. (HON.) ABERD., F. R. S.

THE nervous diseases of the heart may be divided into two classes, according as they affect the sensory or motor apparatus of the organ. These two classes are not altogether distinct, both the sensory and motor apparatus being sometimes affected together, but for the purpose of classification they can be distinguished from each other in a fairly satisfactory manner.

The motor affections may alter the strength or rate of the heart-beats, or both. Those which are usually recognized as nervous are palpitation in which the apparent strength of the beat is increased while the pulse-rate is unchanged, excessive rapidity of the pulse, or tachycardia, excessive slowness, or bradycardia, and irregularity of the pulse. The irregularity may affect either the number or strength of the pulse-beats, or both, and the form in which one beat is dropped in an otherwise regular pulse is designated as simple intermittence. These abnormal conditions may occur without its being possible to show that any organic disease is present, and they are then more particularly to be regarded as nervous.

The sensory affections of the heart occur in the form of uneasiness, oppression, or pain, and may vary from slight discomfort in the cardiac region to the intense agony of severe angina pectoris.

PHYSIOLOGY OF THE CIRCULATORY APPARATUS.

Before entering upon a discussion of the diseases of the heart, it may be advisable to give a short account of the physiology of the cardiac nervous system. This is extremely complicated, and a good deal of difference of opinion exists in regard to it. A description of it at this time must, therefore, not be regarded as absolutely true in all respects. All that can be done at present is to give such an account of it as will best correspond with the knowledge we possess, but it must be borne in mind that new discoveries may not only extend our knowledge, but may lead us to modify considerably the opinions we now hold. The nervous system of the heart and its relationships with other parts of the body are so complex that I may perhaps be

excused for trying to simplify their apprehension by employing a very homely illustration, and comparing the heart with its nervous system to a horse and its driver.

Cardiac Muscle.—It is now generally held by physiologists that the muscular fibre of the heart, like other muscles, both voluntary and involuntary, possesses in itself the power not only of contraction, but of *rhythmical contraction* apart from any nerves or ganglia. Such rhythmical contraction, however, of involuntary muscular fibre is usually displayed only when the muscle is subjected to a certain amount of stimulation. The muscular fibres are less sensitive to stimuli than the nervous, and consequently a smaller amount of stimulation will produce rhythmical contraction, if it can act upon the muscle through the nerves or ganglia, than if it acts upon the muscular fibre directly. The heart may thus be compared to a cart-horse which would stand still if no stimulus whatever were applied to it, but which would walk on rhythmically if stimulated by the prospect of a feed of corn when it reached its stable. It would do this even if blindfolded, but if its eyes were open the sight of the corn, acting through the nervous system, would stimulate it more readily.

Cardiac Ganglia.—But while the heart contains in itself the elements of rhythmical contraction, partly in its muscular fibre, and probably also in part in its intrinsic nerves and ganglia, so that it will beat for a considerable length of time after removal from the body, its movements while *in sitû* are regulated by the central nervous system.

Medullary Centres.—The chief centre by which the circulation is controlled and the beats of the heart are regulated both in strength and frequency, so as to suit the resistance which the organ has to overcome in driving the blood through different parts of the body, is situated in the medulla oblongata. In this part of the nervous system, closely related to one another, we have centres for the heart, for the blood-vessels, and for the respiration, so that the pulse, the blood-pressure, and the breathing may all be kept in harmony with one another. The centres here may be compared to the driver of the cart, who makes his horse move slowly by pulling the reins or quickly by using the whip, and increases or lessens the resistance to be overcome by putting on or taking off the brake when the vehicle is going down or up hill. The reins by which the heart is restrained or inhibited are certain fibres contained in the vagus nerves, the whip is contained in the sympathetic nerves, and the drag is the vaso-motor centre which contracts or relaxes the vessels so that the blood flows through them with greater or less difficulty, and thus a greater or less resistance is presented to the ventricular contractions.

Inhibitory Fibres.—The restraining or inhibitory nerves of the

heart, although contained in the vagus trunk, are really derived from the spinal accessory, while the other nerve-fibres contained in the vagus are probably sensory. The origin of the inhibitory fibres is shown by the fact that when the roots of the spinal accessory have been torn out, and the fibres proceeding from them to the heart have consequently degenerated in accordance with Waller's law, irritation of the vagus trunk ceases to have the power of slowing or stopping the heart which it would have in a healthy animal.

Inhibitory Apparatus in the Heart.[1]—The mode of termination of the inhibitory fibres in the heart has not been made out with certainty, but experiments upon the actions of certain poisons lead to the conclusion that just as the reins are rarely fixed directly to the horse's head, but end in a bit by which their action is increased, so the inhibitory vagus fibres end in some apparatus within the heart and act through them. This conclusion is, to a great extent, founded upon observations made on the heart of the frog. This may not be quite applicable to mammals, but in the absence of more definite information we are at present almost obliged to regard the nervous system of the mammalian heart as analogous to that of the frog. The experiments upon which our observation is founded show that if the vagus trunk be irritated by an interrupted current, the heart-beats are rendered slow, but if nicotine be injected in sufficient quantity, no irritation of the vagus will slow the heart, any more than the driver can stop his horse if his reins have been cut. But if the venous sinus of the frog's heart be stimulated after the vagus trunk has been paralyzed by nicotine, the stimulation will stop the heart, just as the driver might stop his horse by seizing the bit even after the reins were cut. If instead of nicotine we use atropine, neither stimulation of the vagus trunk nor stimulation of the venous sinus will stop the heart, any more than the driver can stop his horse if, instead of the reins being cut, the bit has fallen out of the horse's mouth.

Anabolic and Katabolic Actions.—The inhibitory vagus fibres, while slowing the heart, tend also to maintain or even restore its power, and, while lessening its action for the time being, will prolong the time during which it retains its irritability, in the same way as the judicious use of the rein, rather than of the whip and spur, has enabled men in a race for life across the prairies to reach their destination in safety, while others, who distanced them at the outset, have exhausted their horses and perished. Thus, if three animals be taken, all as nearly alike as possible, and the vagus nerves be cut in one, so that the heart beats much more quickly than normal, while in another they are stimulated, so that the heart beats more slowly for some time, and

[1] This view is not held by some physiologists, but it enables us to explain certain phenomena, and especially the action of poisons, more easily than any other view.

the animals be then all killed and the hearts excised, it will be found that the heart which beat more quickly than the normal perishes the soonest, while that which went slower than the normal outlives the heart of the animal which had not been experimented upon.

The power of the vagus to lessen waste and lead to the storing up of nutriment in the heart has been called by Gaskell anabolic, while its opposite effect—namely, the rapid action, and consequently quick using up of the nutritive material coincident with quick action of the heart, such as is produced by section of the vagus or still more by the accelerating nerves of the heart—has been termed catabolic.

Tonic Action of the Vagus.—In healthy men the inhibitory part of the vagus is always more or less in a state of tonic action, just as the driver gently feels the mouth of his horse and keeps it in hand. The extent to which the vagus restrains the beats of the heart in man has been approximately ascertained by the pulse-rate in cases of poisoning by belladonna or atropine, for in such cases the vagus is completely paralyzed by the poison, and the power of the inhibitory centre in the medulla over the heart is as completely destroyed as if the vagi had been cut across. In such cases the pulse-rate usually varies from 120 to 180. Most commonly it is between 140 and 150.[1] But belladonna and atropine not only destroy the power of the vagus; they stimulate to a certain extent the accelerating nerves of the heart also, for if small doses of atropine be injected into the circulation after the vagi have been divided, the beats of the heart are still further quickened.[2] We may perhaps not be far from the truth if we estimate the acceleration due to the stimulating effect of atropine as equal to ten, fifteen, or perhaps twenty beats per minute, so that we might not be far wrong in assuming that simple removal of the vagus tone would allow the pulse to beat at the rate of 125 to 135, instead of 65 to 75. At the bedside we meet so frequently with a pulse-rate of 120 that one is almost inclined to think that this may be a common pulse-rate when the vagus is inactive.

Accelerating Nerves of the Heart.—The accelerating nerves of the heart, which stimulate it to more rapid and forcible action, are chiefly contained in the sympathetic. The position of the accelerating centre has not been definitely localized. It may, like the inhibitory, be chiefly situated in the medulla oblongata, but acceleration can no doubt be produced by centres lying higher up in the cerebrum. The accelerating fibres pass down in the cervical cord and out by the rami communicantes to join the cardiac plexus. We do not know the exact

[1] *Ueber die Physiologischen Wirkungen des schwefelsauren Atropins*, von A. V. Bezold and Dr. Friedr. Bloebaum, p. 56.

[2] Lemattre, *Archives générales*, August, 1885; *Therapeutics*, by H. C. Wood, 7th ed., p. 296.

nerves through which they pass in man, but in the dog they leave the spinal cord in the anterior roots of the second and third, perhaps also the fourth and fifth, dorsal nerves. They pass in the rami communicantes in these nerves to the ganglion stellatum and first thoracic ganglion. Thence some fibres appear to go upward in the loop of Vieussens to the anterior cervical ganglion, and thence to the heart. Their course, however, is so complicated and varied that it is hard to give any exact account of it.[1]

Sensory Nerves of the Heart.—The vagus and accelerating nerves belong to the efferent class, and convey impulses outward from the centre in the medulla to the heart. They may, as I said, be likened to the reins and whip of the driver of a wagon. But the reins not only convey to the horse the wishes of the driver; they also convey to the driver the intentions of the horse; and in this respect the vagus and the reins resemble each other. For the vagus nerve not only contains efferent inhibitory fibres; it also contains sensory fibres, which convey impressions from the heart to the medulla, and not only produces reflexly such alterations in the contraction of the arteries and in the respiratory movements as will suit them to the needs of the heart, but may even produce pain more or less severe, and thus bring to a stop movements of the limbs or of the body generally when such movements are tending to put upon the heart a strain greater than it can well bear.

Work of the Heart.—But we must now turn from the heart itself to the work which it has to do. This consists in driving the blood into an elongated, branching, elastic tube, the aorta and arteries. This branching tube may be regarded as opening at one end through the capillaries into a nearly empty vessel, the veins. For the venous system is able to contain the whole of the blood in the body, and indeed does so after death, while during life it is so imperfectly filled as to present almost no obstacle to the flow of blood into it from the arteries.

Contraction of Capillaries and Arterioles.—The resistance which the heart has to overcome is therefore almost entirely determined by the difficulty with which the blood can flow out through the capillaries, and this again chiefly depends upon the greater or less amount of contraction which occurs in these vessels and in the arterioles with which they are immediately connected. When these are much contracted the blood flows out with difficulty, the tension in the arterial system rises, and the work which the heart has to overcome at each beat is increased. On the other hand, when the arterioles and capillaries are dilated, the blood readily flows through them into the veins, the pressure in the

[1] For a number of experiments on this subject see Schmiedeberg, *Ludwig's Arbeiten*, sechste Jahresgang, 1871, p. 34.

arterial system sinks, and the resistance which the heart has to overcome is proportionately diminished.

But, as a rule, the arterioles are not equally contracted or dilated at the same time, for their calibre depends upon the need which the part of the body to which they are distributed has for more or less blood. The whole vascular system has been well compared by Ludwig to the water-supply of a large town, such as London, where, the quantity of water being insufficient to supply the whole town at once, the turn-cocks go about cutting off the supply from one district while they turn it on to another. As a rule, then, we find that when the vessels at one part are contracted, those of another are dilated, and *vice versâ*.

Vascular Districts.—There are three great vascular districts in the general circulation which have to be considered—viz. (1) the skin; (2) the abdominal viscera; and (3) the muscles. The vessels of the skin and the viscera are controlled by the vaso-motor centre in the medulla oblongata, and when this centre is excited the vessels both of the skin and of the intestine contract. As a rule, however, when the vessels of the skin are made to contract by the application of cold, and not by stimulation of the vaso-motor centre, the blood, being driven from the skin, passes into the internal organs and abdominal viscera. To some extent, at least, the vessels of the third district—namely, the muscles—are much less under the control of the vaso-motor centre than the other two, unless, indeed, such an arrangement exists in this centre that it actually causes them to dilate at the time when the others contract. It is obvious that if the heart stands still, the blood will continue to pour out from the arterial system into the veins, and that the pressure in the arteries will consequently diminish steadily. One would suppose that irritation of the vaso-motor centre under such conditions would, by contracting the arterioles throughout the body, prevent the escape of blood into the veins, and thus stop the fall of pressure in the arteries. But this is not the case, for Ludwig and Hafiz found that when the heart was made to stand still and the vaso-motor centre was irritated, the blood seemed to pour out through the vessels of the muscles in such quantity that the pressure sank nearly as quickly as when the vaso-motor centre was not interfered with. This curious independence of the muscular vessels is probably of great importance physiologically, and must, I think, be borne very carefully in mind in considering the pathology of shock and syncope.

The calibre of the vessels in the muscles is regulated to a considerable extent by the vaso-motor nerves contained in the motor nerves of the muscles themselves, but their permeability to the flow of blood is also modified to a great extent by the mechanical pressure exerted upon them by the fibres of the muscle during its contraction. We would

naturally suppose that the contracting muscle would require a greater amount of blood than usual in order to supply it with oxygen and nutriment, as well as to remove the waste products generated by its activity, and consequently would look for dilatation of its arteries. And, indeed, this is what we find, for stimulation of the motor nerve of a muscle not only causes its fibres to contract, but causes its blood-vessels to dilate, and the amount of blood which passes through to be consequently increased. This increase, however, is most marked after the contraction is over, for during the contraction itself the pressure of the muscular fibres on the arteries may be so great as to interfere very considerably with the passage of blood through them. The resistance thus opposed to the flow of blood from the arteries into the veins may be so great when many muscles are called into action that the general arterial pressure rises very considerably; indeed, as a rule, a violent struggle in an animal will raise the pressure within its vessels enormously. As the flow of blood through the muscle depends upon these two opposing factors, and perhaps still others not yet fully understood, the amount which passes through the muscular vessels during exertion varies very considerably; and while powerful contractions may sometimes arrest the flow entirely, gentle contraction may increase it considerably above the normal. Thus, while severe exertion may cause a great rise of blood-pressure, gentle or moderate exercise may distinctly lower it. To this point we shall have occasion to refer when discussing the pathology of angina pectoris.

We really know very little about the flow of blood through the muscles in man, although many experiments have been made by Ludwig and his scholars on the lower animals. We may assume that in its main points the regulation of the circulation in muscles is the same in man and in animals; but in man we have to remember that the cerebrum is much more developed than in the lower animals, and that mental affections and emotions may have, and probably do have, a very much greater effect upon the circulation than they do in the lower animals. Although the circulation is certainly very greatly affected by emotion, even in the lower animals, yet we very rarely, if ever, find fainting as a consequence of emotion in them, whereas it is not uncommon in the human subject. During fainting the face becomes blanched and the whole surface of the body pallid. It is usually supposed that this is due to blood having left the surface and gone into the internal organs, but an observation of John Hunter's seems to show that the blood, in fainting, is really coursing with unusual rapidity through the muscles, and that the large area opened to the passage of arterial blood by dilatation of the arteries supplying the muscles leaves the ordinary channels through the surface empty. Hunter observed, while bleeding a lady who fainted, that while the faint

lasted the blood which flowed from the vein, instead of being dark and venous, was of a bright scarlet, like that of arterial blood.[1] From the observations of Claud Bernard on the submaxillary gland we know that the arterial color of the blood in a vein is associated with dilatation of the capillaries, so that the blood streams so quickly into the vein that time is not allowed for it to assume its usual venous condition. Hunter's observation seems to show that while the skin of the arm was blanched, the capillaries of the muscles were so much dilated, the blood simply pouring through them, that at the bend of the elbow it was arterial in character. This contraction and relaxation of the vessels which supply voluntary muscles independently of those going to the skin or to the intestines is, I think, a factor of much importance in regard to the circulation, and one which has hitherto received too little attention, for Ludwig's observation seemed to show that in a given time as much blood may pass through the muscles as would flow through both the skin and intestines together. We can thus see what an enormous effect any change in the circulation through the muscles may have upon the pressure in the arterial system generally, and consequently what a tremendous influence muscular exertion will have upon the heart, especially when the heart is weakened by disease.

It is obvious that the ranges within which the blood-pressure might vary are so great that they would be destructive to the life of the animal were it not that one factor usually counteracts another, and keeps the pressure more or less constant. As a rule, whenever the pressure rises in the arterial system, its increase acts as a stimulus to the inhibitory roots of the vagus, and thus slows the pulse. Less blood is thus sent into the aorta, and the tension within it is brought to the normal and kept there. On the other hand, when the arterial pressure falls the ordinary stimulus to the vagus roots is diminished, the heart acts more quickly, and the tension in the aorta is thus again brought up to the normal. Besides this, whenever the tension becomes so great as to inconvenience the heart, the sensory nerves of this organ bring into action reflexly a mechanism for dilating the vessels. In the rabbit these sensory fibres pass upward from the heart as a distinct nerve, the depressor nerve, and when stimulated they cause great dilatation of the vessels in the abdominal viscera, so that the blood-pressure falls at once.

The exact situation of these nerves in man has not been ascertained, but in all probability a similar mechanism exists. The pulse-rate in health thus depends to a great extent on the pressure within the vessels. In disordered conditions of the nervous system it may vary to a great extent independently of this.

[1] *Works of John Hunter*, edited by Palmer, 1837, vol. iii. p. 91.

Motor Nervous Diseases.

Functional Palpitation.—In healthy conditions of the internal organs one ought to be completely unconscious of their existence, but in functional palpitation the patient becomes unpleasantly aware of his heart by feeling it throbbing. This throbbing may be confined to the heart itself or may be felt also in the vessels. In some cases the sensation which the patient feels is not accompanied by any change in the pulse or heart-beat sufficiently great to be perceptible to others, and the apex beat and pulse appear quite normal, although it is possible that the application of finer instruments of research might show that some change had actually occurred. In other cases, palpitation can not only be felt by the patient himself, but can readily be recognized by others, for the impulse of the heart's action against the ribs is forcible and hammering, and the pulse is frequently quickened, although in some cases the pulse may even be slower than usual. In regard to the conditions which actually are present in palpitation from mental emotion, the experiments of Couty and Charpentier, which are mentioned further on (p. 752), are very interesting, and in discussing the palpitation produced by digitalis I found that the cardiac contractions are actually increased in strength during the continuance of palpitation produced by this drug.[1]

The most common cause of palpitation is mental emotion of some kind, such as fright, joy, sorrow, expectation, and anxiety. These emotions will excite palpitation even in perfectly healthy, strong people, but they do so still more markedly in persons of a nervous temperament and feeble physique. Generally, women are much more liable to palpitation than men. In both women and men the tendency to palpitation becomes much greater when they are weakened by debilitated conditions, either mental or physical, such as anxiety, continued sleeplessness, over-work, over-excitement, hysteria, sexual excess, anæmia, chlorosis, and prolonged lactation.

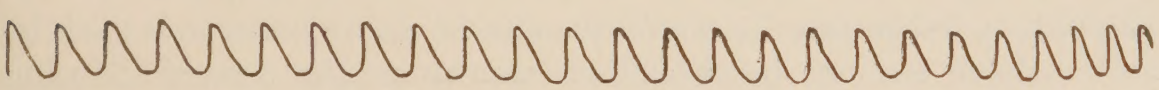
Irritation of the vagus and vaso-motor nerves, whether central or peripheral, may also lead to palpitation, and it may therefore occur from hæmorrhage or tumor in the brain or spinal cord or in the course of the vagus or sympathetic tracts. Reflex irritation of the cardiac nerves, especially from the stomach, is a frequent cause of palpitation. It may occur from some distension of the stomach by flatus or by the presence of indigestible or irritating articles of food. In a case of distension of the stomach by wind a mechanical condition of the heart probably co-operates with the nervous cause of palpitation, for the stomach is separated from the heart only by the diaphragm, and when the stomach is distended it tends to lift the heart out of its

[1] *On Digitalis*, London, Churchill, 1868, p. 28.

normal position and tilt the apex more upward. A similar result may follow distension by a too abundant meal, as the effect of distension of the stomach would be nearly the same whether it were caused by gas or by solid or liquid food. Some cases of sudden death appear to be due to such distension. It is known to occur in animals that have fed upon damp clover, and one of the ancient methods of poisoning was to make the person swallow a large quantity of freshly-drawn bull's blood. This, by forming a large solid coagulum in the stomach, would keep it permanently distended, and thus kill the person to whom it was administered. A case of sudden death which occurred a year or two ago in a man who had taken a large meal of potatoes and milk was probably due to the same condition.

Reflex palpitation may occur from irritation of the abdominal nerves, such as those of the intestine by scybalous masses in cases of constipation or by worms, irritation of the gall-duct by the passage through it of biliary grit or small calculi, by irritation of the kidney in renal colic, or, still more frequently, by the dragging of the renal nerves in cases of floating kidney. Irritation of the uterus and ovaries, either by congestive or inflammatory conditions or by malposition, such as prolapse, are a still more common cause of palpitation. One cause of palpitation which may be looked upon as partly direct and partly reflex is diminished blood-pressure, which may be caused by several conditions. When it occurs through dilatation of the arterioles, the heart, having little opposition to overcome, works, as I have said in a former paper, "fast and loose, like the driving wheel of a locomotive

FIG. 44.



Tracing of the pulse of a healthy young man in whom the vessels have been dilated and the heart consequently quickened by the inhalation of nitrite of amyl.

on a piece of greasy rail."[1] Palpitation may be occasioned in this way by exposure to undue heat, as in a Turkish bath, warm bath, or even warm foot-bath, or by lessening the pressure in the abdomen by the removal of fluid in ascites.

In exophthalmic goitre palpitation of the heart is usually one of the most prominent symptoms. It is usually accompanied by exceedingly rapid action of the heart, though cases are recorded in which the pulse has been abnormally slow.

TOXIC PALPITATION.

It is possible that the palpitation occurring in constipation, gout, and indigestion may sometimes be due to the absorption of toxines

[1] *Practitioner*, 1876, vol. xv. p. 311.

from the intestinal canal. At any rate, we know certainly that some substances are very liable to produce palpitation. Tea is a marked example of this, and more especially green tea. Coffee produces it in some, but not so frequently as tea. Tobacco is also a cause of palpitation, leading to pseudo-angina, which will be discussed later on. Position may give rise to palpitation, and some people cannot lie on their left side on account of the palpitation which they feel in this posture. The cause of this is not quite clear, but possibly it may be due to the mechanical irritation which the heart experiences by beating against the ribs in this position.

Stimulation of the skin over the cardiac region may occasionally give rise to palpitation, and I have seen one case in which it was brought on to such an extent by the application of ammonia over the left breast in a man that the treatment had to be discontinued.

Treatment of Palpitation.—In most cases of palpitation the person involuntarily presses his or her hand over the heart, and the warmth and pressure usually give relief. In persons who are liable to palpitation a substitute for the continued application of the hand may be found in the application of a plaster to the cardiac region. Any plaster that is warm and that sticks firmly will answer the purpose, but belladonna plasters are usually preferred, as they seem to have a more sedative action than others. In applying the plaster it is well to make some cuts in its edge, so as to allow it to adapt itself more accurately to the chest, and in females cuts may be made to allow the plaster to be applied close under the breast.

Some alcoholic stimulation, such as ½ an ounce of brandy, either pure or with its own bulk of water, will frequently stop an attack of palpitation, but in cases in which the attacks are frequent it is inadvisable to have recourse to alcohol, on account of the risk of inducing a habit. In such cases 20 or 30 minims of aromatic spirit of ammonia may be given in water, and this may be made pleasanter, and perhaps even more effective, by the addition of 10 minims of spirit of chloroform and 20 or 30 minims of compound tincture of cardamom.

The action of the heart may be greatly quieted by the administration of small doses, such as 5 minims, of tincture of digitalis, with the same quantity of tincture of nux vomica, three or four times a day; and when anæmia is present, 5 to 20 grains of carbonate of iron in the form of pill, twice or three times a day, will be useful. The bowels should be kept regularly open, and if the motions be pale, small quantities of a mercurial purgative should be administered from time to time, followed by a saline laxative. Where the palpitation is due to mental excitement, bromide of potassium, in doses of from 10 to 20 grains, with saccharin to flavor it may be given either when the mental excitement is felt or at regular intervals at bedtime or dur-

ing the day. In cases of dyspepsia with irritability of the stomach bismuth and hydrocyanic acid will tend to lessen palpitation. Worms, if present, must be removed by vermicides, and if there be a floating kidney it should be supported by a pad, and any abnormal conditions of the genito-urinary organs must receive appropriate treatment.

Paroxysmal Heart-Hurry (Paroxysmal Tachycardia).

In some persons the pulse-rate is constantly high, although there is no fever whatever. In one lady that I knew the usual rate would be from 100 to 120, but she suffered from constant irritation in the rectum and sigmoid flexure and morning diarrhœa. This condition lasted for ten years. In other cases a persistently rapid pulse is associated with the presence of a floating kidney, although a floating kidney does not invariably give rise to this symptom.

In another class of cases the pulse is not persistently high, as in those that I have mentioned, but every now and again it is liable to sudden acceleration. To this condition the name of paroxysmal tachycardia has been given. These paroxysms may be—and indeed generally are—accompanied with palpitation, and are sometimes associated also with difficulty of breathing and pain in the cardiac region, like that of angina pectoris. The difficulty of breathing is sometimes so great as to make the attack resemble one of spasmodic asthma. Cases of tachycardia seem to me to be so much associated with nervous palpitation, with angina pectoris, and with asthma, that it is difficult to draw a distinct line between them.

The attacks last for a time varying from a few minutes to several hours, though they may continue for some days. The frequency of the attacks also varies within wide limits between hours, months, and years. There is also no limit to be placed to the length of time during which the patient is liable to these attacks.

Paroxysmal Slowness (Bradycardia).

In some people the pulse is naturally very slow, and in a fellow-student of my own the normal rate continued to be 42 per minute for years. The slowness may occur in consequence of irritation of the vagus roots by inflammation about the brain or medulla, by pressure from a tumor, abscess, or hæmorrhage, or from irritation by a venous condition of the blood, or by drugs, such as digitalis or tobacco. It appears also to occur in some people from the use of tea or coffee, although this is quite exceptional. It is not uncommon in cases of jaundice, and its occurrence here appears to be due, according to Wickham Legg, to the weakening action of biliary acids on the cardiac muscle.

Slowing of the heart through stimulation of the vagus may be produced reflexly by irritation of the stomach, intestines, or abdominal

organs in the same way as nervous palpitation. It may also be produced by the application of strong vapors, such as ammonia or chloroform, to the nose.

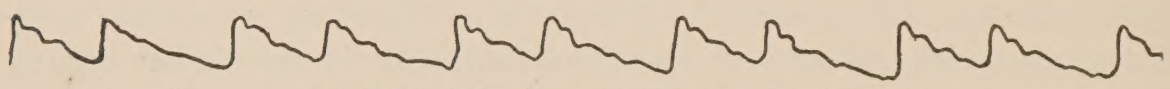
The prognosis, especially in elderly people, must be a guarded one, as the slow heart probably indicates a tendency to organic weakness.

The treatment is to relieve the condition as far as possible where it is due to irritation, and to stimulate the heart by ammonia, nux vomica, and small quantities of alcohol, and to maintain or increase the nutrition of the heart itself by good food, by iron where it can be borne, and by the elimination of waste material either by purgatives or diuretics.

Intermittent Pulse.

It is evident that if the cardiac diastole be prolonged at each beat to such an extent as to occupy the time usually allotted to two pulsations, the pulse will simply be very slow, but quite regular. If the

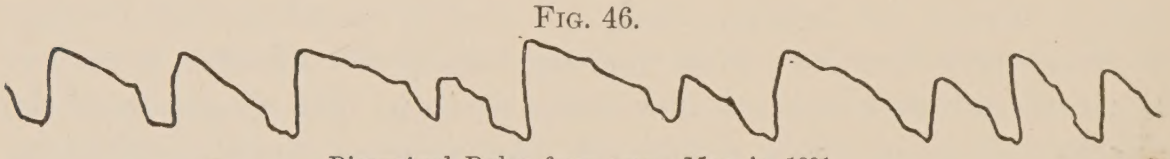
Fig. 45.



Bigeminal Pulse from Healthy Man in 1884.

diastole of each alternate pulsation be prolonged, we get the bigeminal pulse, consisting of two pulsations succeeded by a prolonged interval,

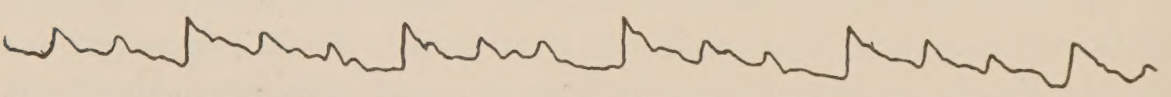
Fig. 46.



Bigeminal Pulse from same Man in 1891.

and if the diastole of every third pulsation be prolonged, we get a trigeminal pulse, and if the intermittence occur at longer intervals than

Fig. 47.



Trigeminal Pulse from Man suffering from Occasional Cardiac Pain.

these, it is usual to speak of an intermission at every fifth or sixth beat, etc.

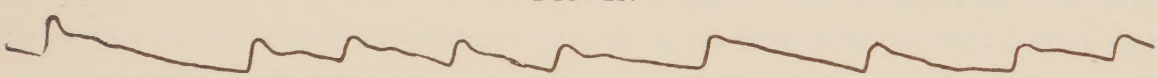
In some cases the intermissions are very regular, but in others they are irregular. Usually, the first beat after a long interval is fuller and stronger than the others. I have known a bigeminal pulse to last for many years in a gentleman of gouty diathesis, but strong and active, able and energetic, and in the enjoyment of complete health all the time.

But the bigeminal pulse, where the beats are also feeble and where the twin character has come on in the course of a severe illness, is of a much more serious character, and makes the prognosis much more grave.

Causation.—The excessive use of tobacco is a common cause of intermittence of the heart. According to my experience, there are two kinds of cardiac disturbance to which tobacco gives rise. The one is accompanied by palpitation and great irregularity of the heart, two or three slow beats being succeeded by four or five quick ones, and these again by two or three slow ones again. This form I have usually observed in workingmen who smoke a coarse kind of tobacco in pipes. The other form is one in which the pulse may seem quite regular when it is felt, but the person suddenly drops down unconscious, as if shot. This form is more common in people belonging to the upper classes, who smoke finer tobaccoes, and especially take them in the form of cigars or cigarettes. Once the tobacco heart has been brought on by excess, it may be kept up by the use of even a small quantity of tobacco, and in many cases the use of the drug must be entirely discontinued.

Intermittence of the pulse may come on from the same causes which lead to palpitation, paroxysmal hurry, or paroxysmal slowness, and in

FIG. 48.



Tracing of the Pulse during Recovery from Poisoning by Digitalis, showing Abnormal Quickness alternating with Abnormal Slowness.

a case of poisoning by digitalis in 1865 I had an opportunity of watching these conditions appear during the process of recovery. When the

FIG. 49.

Tracing from the same Pulse later on, showing Abnormal Slowness.

patient was just recovering from collapse he had a very rapid beat of the heart, probably due to paralysis of the vagus. As he recovered

FIG. 50.

Normal Pulse in the same Case.

slow beats became interposed amongst the quick ones (Fig. 48); then the pulse became regular, but slow (Fig. 49), and finally returned to its normal (Fig. 50).

Prognosis.—Intermittence of the heart may last for many years,

and I have known one case of a lady who died suddenly at the age of eighty-four in whom it had lasted for sixty-seven years. It is especially common in people of gouty families. When it begins to make its appearance in gouty people advanced in years it may be usually looked upon as an indication that the strength of the heart and of the cardiac muscle is beginning to fail, and that measures should be taken to prevent every strain, either from emotion or exercise, to prevent overloading of the stomach, and to increase elimination.

ANGINA PECTORIS.

THE great complexity of that part of the nervous system which regulates the movements of the heart and vessels and their relations to each other renders it very difficult to attain a definite knowledge of its diseases, either functional or organic. Consisting as it does both of afferent and efferent fibres, and of ganglia connected with them, it is evident that we may have, theoretically at least, disorders of these nerves which lead either to motor phenomena alone, to sensory phenomena alone, or to combinations of both motor and sensory disorders in varying proportions. It is probable that in most disturbances, whether functional or organic, of the cardio-vascular nervous system we have both motor and sensory derangement; but in some diseases the motor phenomena chiefly predominate, and in others the sensory, and this predominance may occur to such an extent that we are led almost entirely to fix our attention upon one class of symptoms and to neglect the other.

In angina pectoris there is probably in many, if not in all, cases a certain amount of excessive action in the muscular structures of the vessels or of the heart, or of both, yet the most important symptom, and that which almost entirely attracts the attention both of the sufferer and the physician, is the sensory symptom of severe pain. In the most typical cases of angina this pain is not merely severe, it is perfectly agonizing, and is accompanied with a distressing sense of impending death. But all attacks of angina, even in the same person, are not equally severe; at one time it may amount to extreme agony, and at another to little more than slight inconvenience or depression, hardly deserving the name of pain. On comparing the pain in different persons, also, we find the same irregularity, for while some suffer severely, others suffer very slightly, and, moreover, the pain not only varies in degree and duration in different persons, but varies in character and site.

The problem which we have to solve in trying to ascertain the path-

ological significance of these degrees of pain is very complex and difficult. In trying to do it we may be greatly assisted by the analogy between the heart and the bladder which Dr. Grainger Stewart alluded to in discussing Dr. Douglas Powell's paper. Both the heart and the bladder may be regarded as contractile bags, composed of voluntary and involuntary muscular fibres which contract and dilate at regular intervals. During their stage of dilatation or diastole they become filled with fluid, which flows into them from the veins in the case of the heart, and from the ureters in the case of the bladder. Their rhythmical movements of contraction and dilatation are regulated by the central nervous system, but when cut completely away from it they both continue to contract rhythmically of themselves, and to expel the fluid with which they are filled. In both cases they have to expel the fluid against a certain amount of resistance, which is offered, in the case of the heart, by the contraction of the circular muscular fibres in the walls of the arterioles and the friction of the blood in the vascular system, while in the case of the bladder the resistance is offered by the contraction of the circular band of muscle forming the sphincter vesicæ and the friction of the urine against the walls of the urethra. In the case both of the heart and of the bladder we have such a nervous arrangement as tends to prevent the contractile walls of the viscus and the opposing muscles of the arterioles or the sphincter from contracting simultaneously, at least to their full extent. This is the condition of health, not only in the heart and bladder, but also in other hollow viscera, such as the stomach and intestines. In all of them a certain amount of tone may exist in the fibres which oppose the exit of the contents of any one of these viscera during the contraction of its muscular walls; but when this contraction takes place to its utmost the resisting muscles in each case tend to relax and allow the contents of the viscus to escape. When the innervation of any one of these viscera is so dis-

FIG. 51.

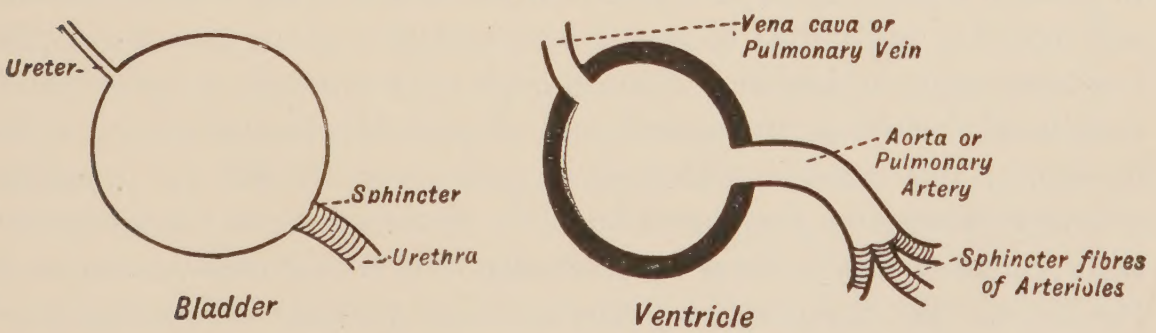


Diagram to Illustrate the Comparison between the Bladder and the Heart.

turbed that its walls contract, and the opposing muscles, instead of relaxing as they ought to do, also contract, we get pain as the result. In the stomach we get distension by gas, or painful retching instead of

the vomiting which might give relief. In the intestine we also get pain when its walls are distended by flatus which cannot escape; and in the case of the bladder, when the urine is prevented, either voluntarily or involuntarily, from issuing when the viscus is fully distended, we have painful sensations, which may vary, just as in the case of the heart, from the slightest discomfort to the extremest agony. In all these hollow viscera distension leads to discomfort or pain in greater or less degree, but in the bladder at least the distension depends, to a certain extent, upon the amount of contraction in its wall; for if this contracts powerfully when the bladder is only about half filled, a distressing sensation and desire to micturate will be felt, which passes off entirely when the contraction ceases, and may remain absent for some time, although the bladder is gradually becoming considerably fuller than it was before. Again, contraction may set in accompanied by pain, and again this passes off, and alternate contraction and relaxation may continue until the bladder is fully distended and the pain becomes excessive, when it is relieved by evacuation, either through the natural passage, by rupture, or by operation. We see, then, that in the bladder discomfort or pain is due to the attempt of the viscus to contract against the resistance which it is unable for the time to overcome. I believe that the same is the case in the heart, and that *cardiac pain is generally due to weakness of the heart in proportion to the resistance which it has to overcome.* This may not necessarily mean that the heart is weaker than usual. It may be that the resistance is abnormally increased; though, on the other hand, it may also mean that while the resistance remains normal, the contractile power of the heart has become weakened, at least for the time.

Pain is usually of peripheral origin, and is useful in giving the organism a warning of some injurious condition which ought to be removed. Thus, pain in the bladder indicates the necessity for evacuating it, and leads the individual to take steps to accomplish this and to prevent injury; pain in a joint usually indicates some inflammation, and leads the individual to give it rest, and thus allow time for repair and restoration to health. But although pain is usually originated by peripheral irritation, the actual seat of painful perceptions is in the cerebrum, and intense sensations of pain may be felt by a patient although there is no peripheral cause for them whatever; and they are then almost certainly due to some condition of the perceptive centres in the brain. We find this in hysteria, where patients have complained of intense pain in the knee-joint, which has led to amputation of the leg, subsequent examination showing the limb to be absolutely healthy. But we may have pain which originates neither in the periphery nor in the centre, but in the paths which connect the two. Thus on striking the "funny bone" we not only get discomfort or pain at the point

where the ulnar nerve is actually struck, but we get disagreeable sensations in the fingers; and men whose legs have been amputated frequently suffer from pains which they refer to a corn on the amputated leg, although years may have elapsed since the member itself has crumbled into dust. The pain in such cases appears to be due to irritation of the nerves in the stump, which, like the blow upon the ulnar nerve, is referred by the sensory centres of the cerebrum—not to the nerve-trunk, but to the terminal filaments from which the nerves of sensation would ordinarily proceed.

In a similar way irritation of the sensory tracts in the spinal cord may give rise to intense pain, which is referred by the sensorium to the periphery, just as is the case in irritation of the nerve-trunks. Thus in sclerosis of the posterior columns we get lightning pains which are referred to the extremities, and also severe pain accompanied by disturbance in the stomach, intestine, and bladder. It is quite probable that the same thing may occur in regard to the heart, for Charcot notes that in the gastric crises of tabes the pulsation of the heart is usually violent and precipitate and the pulse markedly accelerated, although Rosenthal has seen a case in which the pulse was slower than usual during the attack. It is quite possible also that pain may be referred to the heart, although its seat may be entirely confined to the sensorium, and both the heart itself and the nerve-trunks and spinal cord, which connect it with the sensorium, may be quite healthy, just as in the case of the hysterical knee-joint. We know, indeed, that irritation of the trunk of the vagus nerve will produce a feeling of great discomfort in the cardiac region, just as irritation of the ulnar nerve will cause it in the fingers. But the heart is so readily affected by the brain that it is very difficult to find proof of any pain referred to the heart being of purely cerebral origin, and existing without any alteration in the heart itself. The vagus—or, as the Germans call it, *der Herumschweifendenery*, from its wandering course to the heart, lungs, liver, and intestines—is pre-eminently the nerve of emotion, and almost all the emotions can be expressed in terms of the vagus. Thus, "the heart beats high with hope," "his heart sank within him for fear," "his heart fluttered with anxiety,"—all express the effect of these emotions on the stimulating and depressing fibres of the vagus, or mixed effects on the two respectively. The borborygmi, which were used by the ancient writers as a synonym for compassion, the jaundice, which was ascribed to jealousy, and the well-known loss of appetite or sickness which bad news produces, indicates the actions of the intestinal, hepatic, and gastric branches of the vagus respectively.

One might be disposed to look upon emotions as entirely cerebral conditions, were it not that they manifest their effects so distinctly upon the organs just named; and upon the heart, especially, emotion may

act so powerfully as to cause death even in young and otherwise apparently healthy people. Thus Livingstone observed that a great number of slaves who had been torn from their homes died, and when asked what they suffered from they laid their hands upon their hearts, although they knew nothing whatever about anatomy. In many emotions, and especially those that are of a painful character and arise suddenly, the hand is naturally carried to the heart on account of the discomfort felt there. This discomfort, although caused by the emotion, is probably of a peripheral nature, for it may exist after the emotion itself has ceased, as I myself have experienced.

To recapitulate shortly, we may say that in all probability pain in the heart may arise either in the organ itself, in the sensory parts either of the nerve-trunks or spinal cord which connect the heart and sensorium, or in the sensorium itself, although any pure affection of the latter character is probably extremely rare. Though it is theoretically possible that pain referred to the heart may exist in the sensorium alone, it is nevertheless probable that in almost all cases emotional disturbance or other changes in the cerebrum lead to alterations in the function of the heart itself, and that these alterations, rather than the disturbance in the brain, give rise to cardiac pain.

But cardiac pain may differ not only in its origin, but in its nature, and it seems to me that we have at least two kinds of pain, one of which is felt as distension from within, so that the heart seems as if it would burst, while the other is felt as oppression from without, like a giant's hand compressing the chest. The feeling of bursting is familiar to many, for it occurs during or after exertions which are too great for those who undertake them, such as running quickly to catch a train, especially if carrying a heavy portmanteau, or trying to climb a Swiss mountain while out of training. That this condition is associated with actual distension of the right ventricle I had a good opportunity of ascertaining some years ago. In crossing the Théodule Pass at Zermatt my guides began to walk up a steep ascent so quickly that in attempting to follow I got an intense bursting sensation in the cardiac region, with dyspnœa. The discomfort led me to place my hand over my heart, and, to my astonishment, I found that the apex-beat had disappeared from its normal position and that there was marked epigastric pulsation. On calling to them to go slower, they slackened their pace, and as the cardiac discomfort and dyspnœa gradually disappeared I found that the apex-beat gradually left the epigastrium and returned to its normal position.

The heart has two sides and four cavities, and the bursting sensation may occur in any of them. Possibly it may be more usually felt in the ventricles, for the vascular districts of the systemic and pulmonary

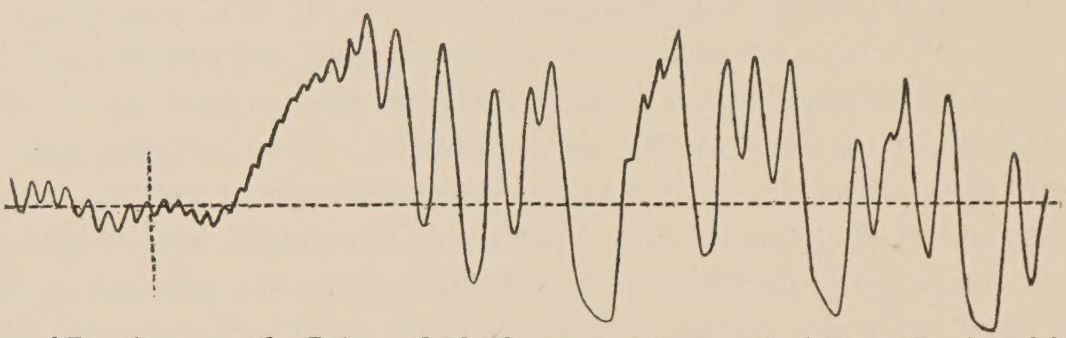
veins, with which the auricles communicate, will dilate if the tension in the auricles becomes too great, and will thus relieve over-distension. The ventricles, on the other hand, have no such means of relief unless their distension is extreme.

I have already pointed out that in the bladder the contraction of the distended viscus upon the fluid within it gives rise to pain, and probably the same occurs with the heart. The right ventricle, when much distended, may to a certain extent be relieved by some backward flow of blood through the tricuspid valves, but the left ventricle is not so favorably circumstanced in this respect, and one would therefore expect that over-distension in it would give rise to much more acute pain than in the case of the right ventricle. At the same time we should also expect that if the mitral valves were incompetent, so as to allow the left ventricle to relieve itself into the auricle and pulmonary veins, the pain of distension would never become so extremely great; and apparently something of this sort does occur. The second kind of pain is that of compression from without like the grasp of a giant's hand upon the thorax, and the name of *Beklemmend*, given to it by the Germans, is exceedingly descriptive. This sensation was first shown by Czermak to depend upon irritation of the vagus. He had a small exostosis upon one of his cervical vertebræ, and by pressing the vagus between his finger and the exostosis he was able to irritate it to such an extent as to slow his heart, and at the same time this sensation of *Beklemmung* came on. His experiments have been repeated by Concato and Quicke, and, indeed, any one by pressing firmly upon the vagus will probably soon experience a sense of oppression that obliges him to desist. Thus in severe migrain the pain in the head is often greatly or entirely relieved by firm pressure upon the carotid, but the thoracic oppression, which is probably due to the vagus being compressed at the same time as the carotid, soon obliges one to give up the pressure notwithstanding the great relief which it affords to the pain.

Pain almost exactly resembling that described by Czermak as the result of the compression of the vagus may be brought on by painful emotions. It may, however, exist completely apart from these emotions, and may persist after the emotion which caused it has passed away. I have noticed this in my own person, for one day while walking in Hyde Park I suddenly became conscious of a sensation of constriction or *Beklemmung* across the chest. It was so uncomfortable that it forced itself upon my attention, and I began to wonder what had caused it. I was walking slowly and the ground was level, so it could not have been exercise; but on puzzling over it I recollected that it had come on near a particular tree some hundred yards back, and that while passing that tree I had been thinking of some painful subject. The painful

thought had, however, completely passed away, and had been succeeded by others of an indifferent nature, and still the cardiac discomfort not only persisted, but increased, or at least engrossed my attention more. That painful emotions affect the heart through the vagus has been very clearly shown by Couty and Charpentier, as is illustrated in the accompanying tracing, which they obtained by connecting a kymograph with the arterial system of a dog paralyzed by curare (Fig. 52).

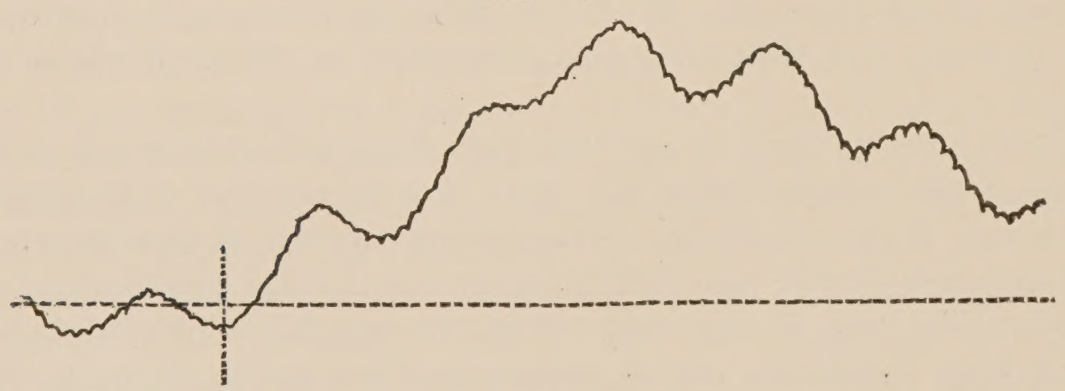
FIG. 52.



Effect of Emotion upon the Pulse and Blood-pressure in a Curarized Dog. The dotted horizontal line indicates the ordinary level of the blood-pressure; the upright dotted line indicates the time when another dog began to howl, and thus excited the animal experimented on. (After Couty and Charpentier.)

The cries which another dog uttered on its toes being trod upon produced in the curarized dog very much the same effect as would have been caused by strong stimulation of the vagus. At the same time, however, it will be noticed that the vaso-motor centre appears also to have been stimulated, and the arterioles consequently contracted; for, despite the slow action of the heart, the blood-pressure is considerably raised, and only falls below the normal during an exceptionally long diastole of the heart. That this slowness of the pulse is due to the effect of emotion on the heart through the vagus is shown in another

FIG. 53.



This tracing shows the effect of Emotion on the Blood-pressure in a Curarized Dog. The effect on the pulse is prevented by previous section of the vagi. The dotted lines have the same signification as in Fig. 52. (After Couty and Charpentier.)

tracing taken under similar circumstances, with the important exception that the vagi has been previously divided (Fig. 53). Here it will be seen that emotion greatly raises the blood-pressure without

slowing the pulse. This rise of pressure, due to emotion, is, I believe, a very important factor in the production of angina, and I shall return to it again later.

It is evident that emotion may have a very complex effect upon the heart, and may under different circumstances produce the feeling of *Beklemmung* due to the action of the vagus, or may give rise to the feeling of distension produced by the excessive resistance which contracted arterioles oppose to the flow of blood through them, and the consequent difficulty the heart has in emptying itself. This feeling is also mentioned in popular language, for people frequently say their hearts feel as if they would burst from grief.

It must be borne in mind that the inhibitory fibres of the vagus not only cause the heart to become slower and weaker, but they tend also to make it dilate beyond its normal size; and such dilatation, it appears to me, renders the organ still more susceptible to the effects of a distending force from within.

The expression "a broken heart" is not found to correspond with the result of *post-mortem* examination; but a persistent cardiac pain, ending in death, may be originated by grief, as in the case of the slaves observed by Livingstone, to which I have already alluded. Of course in such cases as these it is exceedingly difficult or impossible to decide how far the cardiac depression was an exciting or merely a predisposing cause of death; for the weakened circulation would render the slaves more liable to succumb to infectious diseases, malarial or otherwise, by which they might be attacked.

In trying now to apply the physiological data which we have already obtained to the explanation of cardiac pain in general, and of angina pectoris in particular, we may recapitulate in a few words the facts already mentioned. These are that distension of any hollow viscus, as a rule, acts as a stimulus to pain. This pain usually increases with the amount of distension, or rather with the amount of stretching force exerted upon the muscular fibres of the hollow viscus. Thus in the bladder discomfort or pain becomes greater as the bladder gets fuller and the muscular fibres become more stretched; but a spasm of increased pain may and does come on when the bladder contracts. This contraction increases the pressure upon the contents of the bladder, but at the same time it also increases the pressure exercised by the contents upon the bladder-walls, and when these relax so that the pressure again diminishes the pain caused by their stretching tends to cease.

In discussing angina pectoris it may help us if we bear in mind that the most marked symptom of angina is pain—that it is really pain in the heart, though it may be very difficult to draw the line exactly between what every one would call pain and slight forms of cardiac

discomfort which no one would call angina; but between these two extremes we find many intermediate forms, differing from one another by very slight degrees, so that hardly any difference may be distinguishable between adjacent members of the group, although the extreme members may be very different indeed. As Dr. Grainger Stewart pointed out, the analogy between the heart and the bladder may help us considerably. While the bladder, stomach, intestine, as well as the heart, all consist of hollow bags of involuntary muscular fibre, both the heart and bladder have a certain resistance to overcome —namely, that afforded by the friction of the urine passing through the urethra, and the resistance caused by a contraction of the sphincter vesicæ in one case, and the friction of the blood in the arteries along with the contraction of the walls of the arterioles in the other. In both cases there are nervous arrangements for preventing the over-distension of the viscus, and when the pressure in the bladder becomes great the sphincter relaxes. When that of the heart becomes too great the vessels dilate or the heart itself goes more slowly. In both cases we find that the nervous arrangements may be disturbed, so that spasmodic retention may occur in the bladder and over-distension in the heart. In both cases over-distension is associated with pain, and I believe that in both cases the amount of pain may vary, as I have already said, from the slightest discomfort to the severest agony.

But distension only occurs when the contraction of the muscular walls of a hollow viscus is not sufficiently powerful to overcome the resistance opposed to the exit of its contents. Whenever the resistance yields, and the bladder, stomach, intestine, or heart is allowed to empty itself, the pain is relieved or disappears entirely; but in the case of the bladder or the stomach we sometimes find that the muscular fibres of the walls remain in a state of contraction or spasm so great that a few tea-spoonfuls of fluid seem sufficient to produce a sensation of distension and excite the organ to renewed contraction. It is quite possible that a similar condition may sometimes occur in the heart, and that the "irritable heart" and "irritable bladder" may be perfectly comparable to each other; but neither of these conditions gives rise to intense pain, unless there be some obstruction to the heart or the bladder emptying itself of its contents. We may, I think, lay it down as a rule that intense pain in any hollow organ is due to distension arising from the inability of the organ to empty itself of its contents. It is evident that this inability may be of twofold origin: it may be due either to increased resistance, or to the diminished power of the expulsive muscles. In applying this general rule to the case of the heart we may say that cardiac pain is dependent on increased resistance to the onward flow of blood, or diminished power in the heart itself. It is evident that a combination of these two factors will

be still more likely than either one alone to produce cardiac pain, and in searching for the cause of angina pectoris we are most likely to find it in a combination of those leading on the one hand to cardiac weakness and on the other to increased resistance.

It will, perhaps, be most convenient to discuss first the conditions which give rise to increased pressure in the aorta and the arterial system generally. The first is mental emotion, as shown in the tracing already given; the second is bodily exertion. There are few physical conditions, if any, which raise the blood-pressure in an animal so high as does sudden exertion or struggle. The cause of this probably is that the arteries passing through the muscle become compressed by the thickening of the fibres which occurs during muscular contraction; but a counterbalancing condition occurs at the same time, for the muscular fibres which form the walls of the arteries dilate at the time when the muscle contracts. The consequence of this is that the flow of blood through a contracted muscle may vary considerably; sometimes it may be stopped entirely, at other times it may be diminished, while at others, again, it may be considerably increased above the normal, according as the mechanical pressure upon the muscular arteries or the dilatation of their walls is most marked in the particular instance. In almost all cases, however, the flow of blood through the muscle after its contraction becomes greater than usual, an increased supply of blood being apparently requisite for mammalian muscles to perform their functions thoroughly. In consequence of this twofold condition in muscles it frequently happens that while sudden exertion may raise the blood-pressure in the aorta, continued exercise may rather lessen it, the mechanical effect of the muscular contraction upon the arteries being more evident at first, while afterward the arterial dilatation is more evident. A third cause of rise in arterial pressure is sudden stimulation of a sensory nerve; and a fourth is the application of sudden cold, either to the surface of the body or to the stomach, giving rise to contraction of the vessels of the surface or of the digestive tract, and thus causing a rise of general pressure.

The exciting causes of angina pectoris are precisely those which I have just mentioned as raising the blood-pressure.

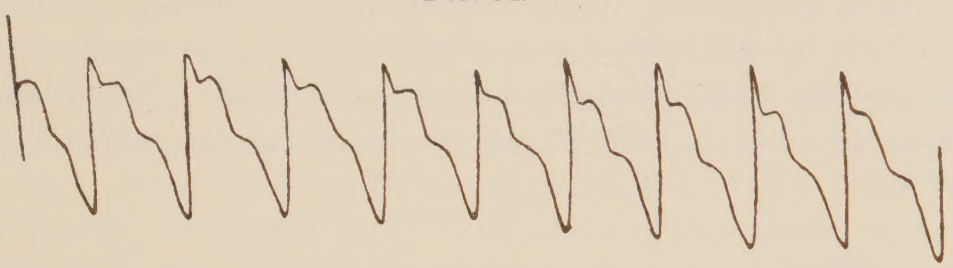
The effect of emotion is well shown in the case of John Hunter, and the most common cause of angina pectoris is the exertion of walking up a hill; but in such cases, especially where the disease is just beginning, though the attempt to ascend a hill may cause pain at first, yet afterward, if the pain passes off and the exertion be continued, the individual may be able to walk for miles, and indeed make considerable efforts, without any return of the pain; which is precisely what we would expect from what has already been said regarding the condition of the vessels in the muscles after continuous exercise.

But the rise in pressure which we have just been considering can only be looked upon as an exciting cause of angina pectoris, for it does not occur in healthy people. One condition which is very apt to lead to angina pectoris is gouty kidney, for this is associated with a high blood-pressure due to diminution in the calibre of the systemic arterioles. Although it is unnecessary to discuss here whether this diminution in calibre is due to a thickening of the walls of the arterioles by arterio-capillary fibrosis, as believed by Gull and Sutton, or to contraction of the muscular walls of the arteries, as thought by George Johnson, it is evident that where the pressure is already high, as in the case of a man suffering from gouty kidney, any sudden increase in it, either from emotion or exertion, is more likely to cause distension of the heart and consequent pain. Yet there are many men suffering from gouty kidney who do not get angina pectoris, and we must now look for its causes not only to the arterial system and the resistance which the heart has to overcome, but to the power of the heart itself in counteracting this resistance. When we come to analyze post-mortem appearances in cases of angina pectoris, we are at once struck by the fact that in the great majority of cases conditions are present which either weaken the heart considerably or tend to lessen its power of meeting, by increased contractile power, any call that may be made upon its powers by a sudden rise in the resistance it has to overcome.

A fatty condition of the heart is naturally one of the most powerful causes of lessened contractile power, and fatty heart has been frequently noted as a post-mortem appearance in cases of fatal angina pectoris; but an inelastic condition of the aorta, with calcification of the coronary arteries, has been noted much more frequently still. At first thought it is difficult to understand what connection a calcified condition of the coronary arteries can have with pain in the heart itself; but when we remember that one of the concomitants of muscular action is dilatation of the vessels which supply the muscle with blood, we can understand that rigid arteries, rendering such an increased supply impracticable, might naturally lead to weakened contractile power, and therefore to pain. In addition to this there may be another factor, and that is disturbed nervous supply; for the interior of the aorta is naturally sensitive, and mechanical irritation of it has been shown by François-Franck to lead to wide-reaching reflex results, among which modification of the respiration is well marked. Such disturbance may in its turn lead to increased resistance to the onward flow of blood, and this in its turn to cardiac distension. That some such disturbance is a powerful factor in the production of pain in angina is, I think, clearly demonstrated by the tracings which I took in a case many years ago, and which first led me to use nitrite of amyl as a remedy for the disease. In a healthy body increased tension within the blood-vessels stimulates the vagus

roots and causes the heart to beat more slowly, so that, less blood being thrown into the arterial system, the diminished outflow through the arterioles is compensated and the pressure remains nearly normal; but in this case I found that simultaneously with the appearance of pain

FIG. 54.



Normal Pulse.

the pressure rose and the pulse became exceedingly rapid (Fig. 55). The form of the pulse-tracing showed that the arterioles were greatly con-

FIG. 55.

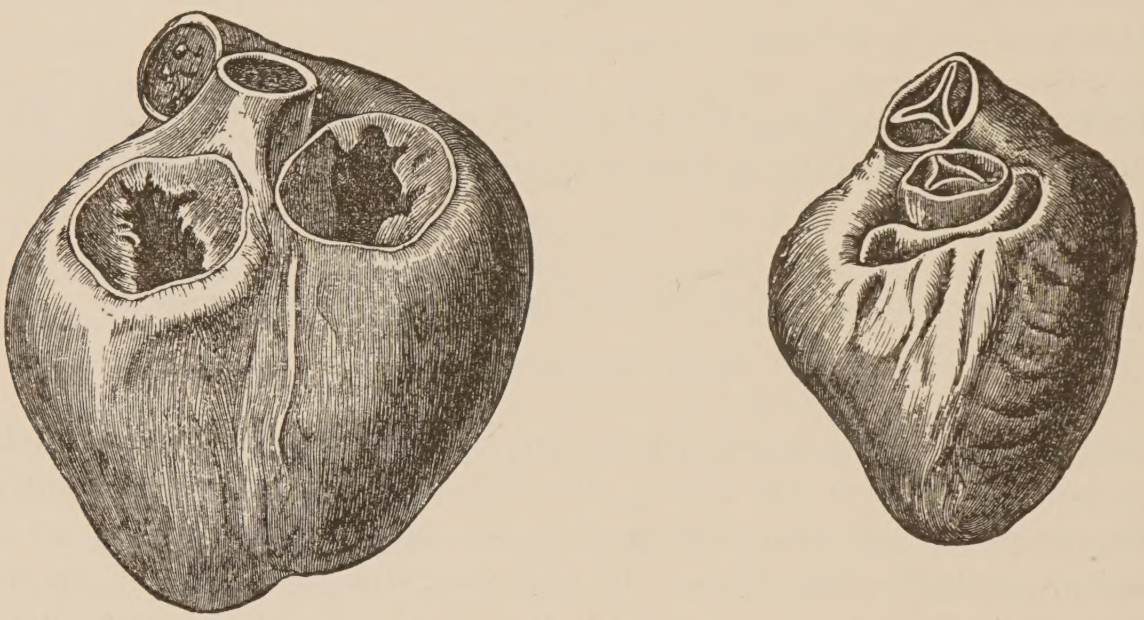
Pulse during Severe Pain.

tracted—so much so, indeed, that during the cardiac diastole a very small proportion of blood was able to flow into the veins, and consequently the pressure remained high during the diastole, instead of sinking as it would ordinarily have done. In this case, which was one of angina pectoris with aortic regurgitation, the blood had an opportunity to run backward into the heart, as well as onward through the arterioles into the veins, and yet the tension remained high during the diastole. This condition can only be explained by contraction of the arterioles, and the high tension which would necessarily result in the heart is, I think, the cause of the pain. This idea, taken in connection with the fact that bleeding usually relieves the patient for the time being, led me to use nitrite of amyl, and the result completely confirmed my expectations. But it may be said that my observations disproved my hypothesis, because I found that after relieving the tension in the arterial system by the use of nitrite of amyl pain still might persist, though to a less extent. This, however, I believe, was probably due to the right side of the heart being involved as well as the left; and when the drug had completely produced its physiological action of dilating all the vessels in the body, the pain disappeared and did not return.

I have already drawn attention to the fact that relief to distension lessens the pain in hollow viscera, and from this fact we naturally expect that the right side of the heart would suffer less than the left, because the right ventricle, when over-distended, is more readily

relieved by the auriculo-ventricular orifice dilating and the blood regurgitating into the auricle and veins between the flaps of the tricuspid valve, which then became incompetent to close the dilated orifice. Dilatation of the mitral orifice occurs much less readily, and therefore the distended left ventricle cannot relieve itself so easily, and is much more likely to suffer pain in consequence. It has been noted, however, that when mitral regurgitation occurs the pains of angina pectoris become less frequent and severe, or may disappear altogether in cases in which they formerly existed. (See Fig. 56.)

Fig. 56.



The Heart in Full Dilatation and in Full Contraction. It will be seen that in complete dilatation the auriculo-ventricular valves, though healthy, can with difficulty close the dilated orifices.

In children also, where the cardiac walls are much less hard and resistant than in adults, we would naturally expect angina pectoris to be much less frequent, as the left ventricle would be likely to discharge itself into the left auricle and pulmonary veins, in much the same way that the right ventricle does in adults. Eichhorst mentions two cases of children in whom angina pectoris occurred. One case was that of a boy aged fourteen years, who was suffering not merely from aortic incompetence, but from mitral stenosis; and in this case one would expect that the contracted mitral valve would tend to prevent any free dilatation of the mitral orifice and relief of the ventricle by free regurgitation. In the other case, which was that of a boy aged eleven years, the auriculo-ventricular ring was to a great extent calcified, so that the enlargement of the mitral orifice and regurgitation would be prevented.

The factors which we have now considered in the pathology of angina pectoris seem to indicate that the pain is due in most cases to cardiac distension, caused by the resistance in front being too great for

the ventricle completely to overcome it, while at the same time relief by regurgitation is prevented. The increased resistance may be either absolute or comparative. It may either be greater than that which would occur in a healthy person, or may simply be too great for a weakened heart, although probably in most cases the resistance is above the normal and the cardiac power is below the normal. In all cases, however, there is a disturbance of the vascular nervous mechanism, which would tend, either by slowing the heart or dilating the vessels, to adjust the action of the one to that of the other, and thus to keep the blood-pressure at the proper height, neither allowing it to fall too low nor to rise too high. The nervous mechanism, in all probability, may undergo central disturbance, and thus we may have attacks of angina pectoris of an epileptic or hysteric nature, and more especially they may be caused by emotional disturbances. We may also have them from disease of the nervous paths in the spinal cord, as in the case of locomotor ataxia, or of the cardiac nerves, as by tumors; and in all probability we may have also reflex disturbance, caused by derangement of other organs. One case which I saw some years ago was probably an instance of one or other of the last-named varieties, though it would be hard to say whether the pain was due to implication of nerves or was reflex from a neighboring part of the body. The case was that of a man aged thirty-six, who complained of pain in the chest under the left nipple, shooting through to the back and running down the left arm as far as the elbow. During the attacks his medical attendant found that the pulse was not quite regular and that the face was pale. He had taken nitrite of amyl, but it seemed only to make him worse. On pressure over the sternum opposite the second and third costal cartilages I found that it was excessively tender and slightly swollen. I learned that he had suffered from syphilis twelve years before. I advised the use of iodide of potassium. In a short time after beginning the drug his pain left him and did not return. Here the anginal pain might be due to reflex irritation from a commencing node over the sternum, or might possibly be due to thickening, involving some of the cardiac nerves.

The high arterial tension which occurs in cases of gout is a very powerful agent in bringing on the attacks. Not only does the arterial tension do this directly by the increased resistance it offers to the heart, but gout is frequently liable to render patients very irritable and give rise to those emotional disturbances which are sometimes fraught with such fatal consequences. For both reasons, therefore, it is very important to cause free elimination both from the bowels and from the kidney.

In a case which I saw lately, a seaman aged thirty-nine, with a hypertrophied heart and a soft systolic murmur at the apex, the pain

came on acutely over mid-sternum, and was limited to an area the size of a crown-piece opposite the insertions of the fourth and fifth cartilages. Nitro-glycerin did him no good, and when walking he was obliged to stop every fifty yards on account of the pain. Iodide of potassium, in 10-grain doses thrice daily, greatly relieved him, but he seemed to receive more benefit from sulphate of magnesium, in drachm doses three times a day, than from either of the other remedies.

A form of elimination not much in vogue, but which is sometimes exceedingly useful, is bleeding, and in the case in which I first used nitrite of amyl bleeding invariably prevented the recurrence of the pain for one night, when without it an attack would have been certain to occur. The natural indication for relieving the pain at the time is certainly to lower the blood-pressure, and this is most rapidly and efficiently done by the administration either of a nitrite or of some other substance which acts in the same way as a nitrite. Nitrite of amyl is the one which is the most commonly used, but, according to the recent researches of Cash and Dunstan, the nitrites which act most powerfully are the following, the first being the most energetic: (1) secondary propyl; (2) tertiary butyl; (3) secondary butyl; (4) isobutyl, nearly equal; (5) tertiary amyl; (6) α-amyl; (7) β-amyl, nearly equal; (8) methyl; (9) butyl; (10) ethyl; (11) propyl.

Of these substances, the isobutyl has already been used with good effect. Along with Mr. Tate, I investigated the physiological action of nitro-glycerin in 1876, and showed that its action was the same in character as that of nitrite of amyl. On account of the headache which it caused Mr. Tait and myself, I hesitated to give it to patients, but in the following year it was successfully introduced into medical practice by Dr. Murrell. Both nitro-glycerin and nitrite of sodium, recommended by Dr. Hay, have the advantage over nitrite of amyl that they can be more readily used to keep up a steady diminution in the blood-pressure, and the plan of giving small doses of nitro-glycerin at frequent intervals during the day is sometimes most advantageous. The best way of doing this is to break up a chocolate nitro-glycerin tabloid into many pieces, which are put into a *bonbonnière*, and one of them taken every ten minutes or quarter of an hour. In this way the action is never very great, but is kept up with a considerable amount of constancy during the whole day. Some experiments which Mr. Bokenham and I have made with hydroxylamine have shown it to have an action almost exactly like that of nitrite of amyl, and I intend shortly to try it in angina pectoris, where I expect it will probably have a beneficial action.

But while we may try to avoid sudden increase of tension from exercise or from emotion, and to diminish the excessive tension in cases of gouty kidneys by free elimination and by an almost entirely

vegetable diet,—while we may lessen the tension during the attack by nitrites and allied remedies, we must think at the same time of the enlargement of the heart and try to increase its force as best we can.

The first and foremost, perhaps, amongst the drugs that are really efficient in tending to prevent the recurrence of the attacks in angina pectoris comes iodide of potassium in doses of 5 to 30 grains three times a day. Whether this acts as a simple eliminant, or whether it tends to increase the blood-supply to the heart by causing absorption of the deposits which block the coronary arteries, or whether it acts in some other way, we cannot at present tell, but about its practical use there can be no doubt whatever. In cases of fatty degeneration we may combine elimination with the administration of iron and of arsenic, and Oertel's method of gently graduated exercise may be beneficial if used with great caution, but if used carelessly it may be most injurious and greatly shorten the patient's life.

In conclusion, I ought to say a word about tobacco. In a healthy person it tends to cause great cardiac derangement; in some it produces great irregularity of rhythm and the patients complain of palpitation; in others it causes sudden faintness, so that the patient drops down insensible as if he had been shot. The first kind of tobacco-heart I have seen is almost entirely in working-men, who smoke a coarse tobacco; the second form I have seen in those belonging to the upper classes, who have smoked fine tobacco. Besides its effect upon the heart, tobacco has a most extraordinary power to contract the vessels, and perhaps there is no other drug that in a somewhat large dose can raise the blood-pressure so rapidly and so much as nicotine. It must not be concluded, however, from effect of these poisonous doses that smoking in great moderation is certain to be injurious. Each individual case must be judged upon its own merits, and while moderate smoking may be allowed in some, it must be entirely forbidden to other patients suffering from angina pectoris.

DISEASES OF THE BLOOD-VESSELS.

By FREDERICK C. SHATTUCK, M. D.

Diseases of the Arteries.

Acute inflammation of the inner and middle coats of the arteries is relatively rare, and more apt to result from the irritation of an embolus than from any other cause. It is manifest that treatment is possible only when a peripheral vessel is affected, and it is then comprised in rest—local, general, or both—soothing applications, and morphine or other anodyne if pain demands their use. Should aneurism develop, surgical measures alone are in order.

Periarteritis, the result of injury or of the extension of inflammation from surrounding parts, also comes within the province of the surgeon rather than of the physician: if an accessible abscess forms, it should of course be opened.

Chronic inflammation (atheroma, arterio-sclerosis, endarteritis deformans), so often combined with degenerative processes, does not present a very fruitful therapeutic field. Could we prevent syphilis and the abuse of alcohol, could we ensure everybody against excessive bodily and mental strain, we should go far to obviate the necessity for trying to treat these arterial changes and their allies, concomitants, and results; at least until a late period of life. Plumbism is, according to English writers, a preventable cause which is worthy of mention.

It is not often that the physician has the opportunity in connection with this disease to exercise his highest function—prevention. Changes are usually more or less advanced when their subjects come under observation. As is indicated above, the chief means of prevention consist of a strictly hygienic manner of life. There is reason to believe that arterio-sclerosis may be a matter of inheritance, but that the tendency can be effectually combated or delayed by temperance and moderation in all things—food and drink, work and play—and by the cultivation of an equable temper. It is highly probable that the wear and tear of modern life, the fierce struggle for wealth and position, prove as disastrous to the integrity of the arterial walls as does a life of ease with its temptations to over-indulgence of the appetites and to sloth of mind and body. It is to be hoped that this latter tendency may be counteracted by the favor now shown to athletics, and

by the habits of self-denial which their pursuit entails to a greater or less degree on all their votaries. At the same time, we recognize the dangers of indiscriminate and undue indulgence here as well as elsewhere.

Endarteritis may be more or less general, or it may be local. The local form, as seen especially in the brain, heart, and kidneys, does not lie within the scope of the present article. The treatment of the general variety should be causal as far as is possible—not far usually, it must frankly be stated. The arteries which are the favorite seat of syphilitic changes are those of the brain. It is, moreover, impossible to be sure whether a syphilitic arteritis has gone beyond the point up to which retrogression may take place under the use of potassium iodide and mercury. The patient should therefore be given the benefit of the doubt and full antisyphilitic treatment.

Apart from those cases in which the changes can be reasonably laid at the door of syphilis, the treatment of arterio-sclerosis varies with the presence or absence of compensatory cardiac hypertrophy. If this be present, it should be our aim to maintain it by careful regulation of the diet and exercise. The nutrition of the heart-muscle depends primarily on the free circulation through it of healthy blood in sufficient amount, while the main source of the blood is, of course, the food. This should be simple, nutritious, easily digested, and given in such amount and at such intervals as the individual case seems to require. A constant supply of pure air and sufficient sleep are of the greatest importance. Careful and specific directions should also be given as to the amount and character of exercise, bathing, and clothing, it being remembered that the kidneys are seldom perfectly sound in these cases. It is almost impossible here to do more than indicate general principles. Success depends on the thoroughness of the physician and on his skill in individualizing his patients and inducing them to carry out his injunctions, however unwilling they may be to do so. But it is not enough to see that the conditions for the formation of healthy blood are met: its purification must also be ensured. The measures of general hygiene above alluded to minister to this end, but they must be supplemented by careful attention to the bowels and kidneys. The retention of excrementitious products is believed to be a potent cause of increase in the arterial tension, a continuance of which favors changes in the vascular walls, and also makes greater demands upon the left ventricle—demands which in time can no longer be met, and which hasten the predominance of dilatation over hypertrophy. In fat and plethoric persons limitation in the fluid ingested, further reduction in the blood-mass by watery catharsis at stated intervals, and graduated exercise should be cautiously combined with suitable diet. The essence of the various and apparently conflicting systems for the reduction of

corpulence is simply an avoidance of excess. But all efforts in this direction should be well considered and tentative, and the reduction must, above all, be very gradual.

In cases of general atheroma we are between two fires. If the heart is weak, nutrition suffers; if it is strong, there is danger of the rupture of a cerebral artery or miliary aneurism. Hence the obvious necessity of avoiding over-, and especially sudden, exertion. There are, in many cases, no certain means of arriving at accurate knowledge of the condition of the cerebral vessels. If the radials and temporals are diseased, so are presumably also the vessels of the brain. But the latter may be the seat of advanced changes, although the former appear healthy. We must therefore often take the chances and follow general principles. It is, moreover, notorious that individuals whose peripheral arteries are calcareous to the last degree not infrequently enjoy a life of surprising length and comfort.

The drug-treatment is always of secondary importance, except where the vascular change is of syphilomatous nature. Here potassium iodide should be given in initial doses of 10 or 15 grains thrice daily, and it is probable that the simultaneous administration of mercury tends to render the effects of the potassium salt more permanent. If the symptoms are urgent or do not promptly show signs of yielding, the iodide should be increased steadily and more or less rapidly until either the desired effect is produced or the drug disagrees. Improvement or iodism are the indications for dosage, not the number of grains. A convenient manner of administering the drug is in concentrated aqueous solution, 1 minim of which represents about 1 grain. Free dilution is important, and milk will often be found a good vehicle. In some cases large doses are well borne although small ones provoke discomfort. It is not, perhaps, a matter of great importance what mercurial is used, unless it is desirable to bring the system rapidly under the influence of the remedy; in that case inunction is generally admitted to be the best. But inunction is a dirty, time-consuming, and tell-tale method, to which others are in ordinary cases to be preferred. The protiodide in $\frac{1}{6}$-grain pills is a convenient form, but should never be given at the same time as the potassium iodide, lest the more poisonous biniodide of mercury be formed. By giving the potassium iodide fifteen minutes before meals and the mercury after meals, all danger is avoided. The number of pills can sometimes be gradually increased with advantage up to six or nine a day, the usual precautions being taken against salivation.

We are acquainted with no drug which can very materially influence endarteritis of other than specific origin. The treatment must here be emphatically of the patient, rather than of the disease. Potassium iodide is often given, more commonly in doses of under

rather than over 10 grains, three times a day. Bartholow and some others claim that salts of gold have the power to prevent the formation or to cause the absorption of connective-tissue growth, and are hence indicated in arterio-sclerosis. The remedy is generally given in the form of the double chloride of gold and sodium, $\frac{1}{20}$ to $\frac{1}{10}$ grain after meals.

In cases of persistently high arterial tension the labor of the heart can be lightened by the use of the nitrites. Of these the most convenient and stable is nitro-glycerin, the ordinary dose of which is 1 minim of the 1 per cent. alcoholic solution. This is now to be had in tablet triturates, for elegance and convenience leaving nothing to be desired. One of these can be given from two to six times a day, according to circumstances, among which is to be reckoned individual toleration. In some persons the dose must be smaller, but it should never be pushed to the point of headache and flushing of the face, except for the purpose of determining the limit of toleration. The relaxant effects of the nitrites on unstriped muscular fibre are certainly remarkable. Diuretics, diaphoretics, and purgatives may be so used as to do good service in cases of high tension.

If the compensatory hypertrophy of the heart is failing or has failed, the indications for treatment become quite different. The leading one of these is the restoration of sufficient vigor to the heart-wall, if this be possible. Rest is here imperative, except in cases of obesity with presumable large accumulation of fat in the subpericardial tissue. In such cases the treatment known by the name of Oertel may be applicable, but only under the careful supervision of an intelligent and cautious physician. In combination with rest, a nutritious diet with frequent small meals, an abundant supply of fresh air of moderate temperature, with proper precautions against chill—a weak heart presupposes a poor circulation—and freedom from excitement and worry are of the greatest importance. Alcohol is here indicated, especially if the appetite and digestive power are impaired. As to the form, no absolute rule can be laid down, but in the majority of cases whiskey and water is the best. It may be necessary to stimulate the appetite also by one of the vegetable bitters before meals, of which nux vomica or strychnine is the best. The value of strychnine is not only in its stimulating action on the gastric mucous membrane, but also in its tonic effect on the heart, and probably the vessels. If there is any tendency to angina, this drug, if used at all, should be given with great caution and only in small doses.

The natural digestants, pepsin and hydrochloric acid, are usually not necessary, the feeble digestion being largely dependent on sluggish circulation and consequent defective secretion, and thus tending to mend with an increase in heart-power. This is to be striven for

with the aid of digitalis or one of its allies. If it be true that digitalis increases arterial tension, while strophanthus does not, this is a class of cases in which the latter is to be preferred. But it is probable that this difference in action is, in the present state of our knowledge, somewhat theoretical; and most of us in practice turn first to digitalis: if this disagrees or fails, the other members of the group—strophanthus, convallaria, sparteine, adonidine, caffeine, helleboreine, etc.—may be used in turn. Special care should be taken to guard against overdosage with any of these remedies, omitting them, at least temporarily, when the quantity of urine reaches or nearly approaches the normal. If it is desirable to continue digitalis for some time, the valuable suggestion of Balfour may be followed—to give it, namely, only twice a day, the doses being separated by an interval of twelve hours. Danger of cumulative action is thus largely obviated, and the drug may be taken steadily for long periods with great benefit in some cases. The effect of the diffusible cardiac stimulants is only transitory, but aromatic spirit of ammonia, compound spirit of ether camphor, musk, and the like may be so used as to render valuable service.

Sleep is of the utmost importance, and must be secured by artificial means if it does not come naturally. Morphine is often the best hypnotic in these cases, quite apart from asthmatic and anginose attacks, in which it is nearly indispensable. Of the less powerful hypnotics, those which, like chloral and the modern antipyretics, tend to depress the heart, are to be shunned.

Degeneration of the arterial walls occurs in three forms—fatty, amyloid, and hyaline. Of these the most common is the former, but it is almost always so closely associated with changes which are classed by pathologists as chronic inflammatory that it has been already considered in the previous pages. It only remains to add here a word as to the tendency of anæmia, resulting in deficient oxidation, to provoke fatty degeneration. The therapeutic bearing of this fact is sufficiently obvious.

Amyloid change in the vessels may be inferred if its presence can be recognized clinically in the liver, spleen, or kidneys, and not otherwise. The treatment, of course, is that of the chronic syphilis or suppuration to which the change is secondary. Hyaline degeneration cannot be recognized during life, and consequently requires no further mention here.

Arterial thrombosis is the result of a feeble blood-current and of roughness of the inner coat of the vessel, or else it forms behind an embolus partially or totally occluding the lumen. This statement indicates the line which prevention should follow as far as is possible. After occlusion has taken place our efforts must be confined to such

measures as favor the establishment of collateral circulation. If a cerebral or visceral vessel is thus affected, all we can do is to enforce rest and strengthen a weak heart-beat: the necrosis of gangrene which may follow the plugging of an important artery of an extremity may render amputation necessary. An underlying diabetes must not, of course, be overlooked.

Embolism of an internal artery offers, perhaps, even less opportunity for treatment than does thrombosis, in that the heart is less likely to need stimulation. Potassium iodide is often given, but there is no evidence that it is of real service unless syphilitic arteritis is present: even then the drug cannot, in all probability, promote the absorption of an embolic or thrombotic plug or restore life to necrotic tissue, though it may do much to prevent recurrence of occlusion. Prevention of the formation of endocarditic vegetations is but little within, that of their detachment is quite beyond, our power at present. Embolism of a main branch of the pulmonary artery is immediately or rapidly fatal: if a medium-sized branch is affected, the heart is likely to demand prompt stimulation, but thrombosis often works backward toward the right ventricle. Infarction of a lobular branch is often latent and requires no treatment, even if diagnosed, unless it is followed by pleuritic pain. In splenic and renal embolism also pain is the sole indication for treatment. Embolism of a large branch of a mesenteric artery may occasionally be recognized during life, but we can do little or nothing for it beyond keeping the patient alive as long as possible. Emboli from a foul source are liable to be followed by suppuration, and the resulting abscess, if accessible, is to be opened as early as may be. The writer has seen such abscesses, seated in the skin and derived from malignant endocarditis—which, in its turn, was secondary to dysentery—spread for a time and then heal perfectly, though the patient finally died. The treatment of cerebral embolism will be found in another part of this system.[1]

Fat embolism of the lungs, generally the sequel of trauma with laceration of fat tissue, is not amenable to direct treatment.

Dilatation of Arteries—Aneurism.

Under this head it is proposed to consider aortic dilatation and aneurism alone, these conditions of peripheral vessels belong eminently to the surgeon.

The indications for the treatment of aortic aneurism are simple enough. Obliteration or contraction of the sac is the end desired, and the chief medical means of its accomplishment is reduction in the force and frequency of the heart-beat, with an increase, if possible—but at least no diminution—in the coagulability of the blood.

[1] See article on Apoplexy, etc., in Vol. III.

The difficulty lies in meeting these indications, and is twofold. Our means are so very seldom productive of anything more than palliation, and most of them are so severe, that a physician thus affected would generally prefer a shorter life—if, indeed, that is to be called life which consists in absolute disability for a prolonged period without any reasonable prospect of radical benefit—to subjecting himself thereto. Drs. Murchison and Hilton Fagge worked to the last. But most of our patients are not physicians and, perhaps happily for them, cannot take a physician's point of view. There is no question, moreover, that life can be prolonged and suffering alleviated in most cases, while here and there in medical literature reported cases of cure are to be found. At all events, it is certainly our duty to do all that we can in every case.

The leading principle of management, the diminution of intra-vascular pressure, has been recognized since the days of Hippocrates, and was carried to its logical extreme by Valsalva, though his repeated bleedings have fallen into disuse, because we believe that they tend to defeat their own object, in that under them the irritability and frequency of the heart are increased. Restriction in diet also, if carried too far, lessens the coagulability of the blood. The purely medical treatment of the present day, therefore, is mainly that of Tufnell, though the limitation of the ingesta is not usually carried to the full extent recommended by him. His dietary is—2 ounces of bread and butter and 2 ounces of milk for breakfast; 2 or 3 ounces of bread and 2 or 3 ounces of meat for dinner, with 2 to 4 ounces of milk or claret; 2 ounces of bread and 2 ounces of milk for supper. With this is to be combined the maximum degree of bodily and mental rest, sudden exertion or emotion being especially shunned. Straining at stool is to be guarded against; coitus is to be forbidden. This treatment makes such demands on the self-control and fortitude of a patient that it can be very seldom carried out for a sufficiently long period to yield its best results, especially as we cannot hold out much hope of a real cure. And it may be added here that the nature of his trouble and the rationale of the treatment should be set forth to the patient with a fulness which must depend on his character and his circumstances as influencing the rigidity of the course to be pursued. In actual practice a larger liberty is, and must usually be, allowed than is above set down. We must do the best we can with each patient, keeping constantly in view the main principle of avoiding unnecessary, and above all, sudden, exertion. This principle is not invalidated by the very rare cases in which the subjects of aortic aneurism have led active, perhaps laborious, lives for periods that one would have said to be impossible.

The drug-treatment is limited to opium or other anodynes for pain, and sedatives or hypnotics as adjuvants or promoters of rest; the only

direct remedy which can claim any really trustworthy evidence of success is potassium iodide. The constipating tendency of opium and its derivatives must be guarded against; but the danger of acquiring the opium habit need not weigh heavily on our minds here if pain can be alleviated or wearing discomfort markedly lessened. If the same end can be attained by chloral, phenacetin, or its congeners, etc., so much the better. Balfour is a very prominent, though he was not the earliest, advocate of the employment of potassium iodide, the good effect of which seems to be more clear than does its mode of action. Balfour thinks that this is "mainly by some peculiar action on the fibrous tissue, whereby the walls of the sac are thickened and contracted, while if coagulation should take place within the sac, it plays but a very secondary and unimportant part and depends for its occurrence solely on the condition of the blood, and is in no respect due to the iodide of potassium." Bramwell doubts the occurrence of this hypertrophy. Both lay stress on the influence of the drug in reducing the blood-pressure and relieving the tension within the sac. Balfour does not now advocate such large doses as he did at first. The blood-pressure is to be lowered without increasing the frequency of the pulse. A case coming under treatment is therefore to be put to bed for a few days without medication until the normal pulse-rate of that individual while at rest can be determined. Ten grains of the iodide are then to be given thrice daily, and the dose is to be gradually increased, provided that the pulse-rate does not rise: Balfour finds that 15 grains is the maximum, 10 often the better, dose. It should be continued for months. He believes that, even without rest, the drug can render great service. No other remedy is used so much in the treatment of aortic aneurism at the present day, and it is generally given in larger doses than seems to Balfour desirable in the light of his later experience.

The application of an ice-bag over the tumor often allays pain, and may possibly promote coagulation. We are cautioned to be very careful in its use if the walls are thin or the skin discolored, lest rupture be hastened through impaired nutrition of the cutaneous layer. Ice over the heart itself tends to moderate its action, and may thus be distinctly serviceable. A small venesection is said sometimes to relieve pain markedly, and should be tried if milder means fail. The chloride of barium may be given in pills of $\frac{1}{10}$ grain each three times a day after meals, with advantage in some cases. A patient of the writer with aortic disease has found the greatest relief from attacks of severe angina from the barium salt, which he has taken uninterruptedly now for twelve months. He is a person of unusual intelligence, and says that "the pain is there, but is kept in control." To cut short an anginose attack nitro-glycerin is the best remedy.

Pressure, the aim of which is to slow or obstruct the blood-current, and thus bring about coagulation within and obliteration of the sac, in its several means of application so useful in aneurism of peripheral arteries, can obviously render little, if any, service in thoracic aneurism. The writer recalls a case in the Boston City Hospital some years ago in which sheet lead was accurately moulded to the surface of the tumor, the number of sheets being gradually increased. Some diminution in the swelling took place, but absolute rest was simultaneously enforced. Sand- and salt-bags have also been used. Abdominal aneurism has been successfully treated by compression with a tourniquet under an anæsthetic by Murray of Newcastle and others. Woirhage[1] has collected 9 cases thus treated, with 6 good and 3 fatal results. Unfortunately, the most frequent seat of abdominal aneurism is just below the diaphragm, a point at which pressure cannot be applied. Before putting on the tourniquet the bowels should be freed, as far as is possible, from both liquid and gaseous contents; and Murray advises that complete arrest of the circulation through the sac should be aimed at for four hours. If on removing the tourniquet no impression has been produced on the pulsation, the first attempt must be considered at an end; but if the pulsation is somewhat diminished, the instrument should be reapplied for another hour. If the first attempt is unsuccessful after an interval of a few days, pressure should be maintained for six to eight hours; finally, even to twelve. The fatal results have been due to injury to the abdominal viscera, especially the intestines—ecchymosis, rupture, and peritonitis.

Langenbeck reported favorable results from the hypodermic injection of *ergotin* over, or in the neighborhood of, the sac: the method has fallen, doubtless justly, into disuse.

Acupuncture was first practised by Sir E. Home, and of late years by Constantin Paul;[2] it is now used in combination with the galvanic current.

Electrolysis.—The power of the electric current to coagulate albumin not unnaturally suggested its use in the efforts which have been made for years to cure, or at least ameliorate, a malady so intractable as aortic aneurism. It is said to have been tried first by Phillips in England, soon after by Petrequin of Lyons. Both needles have been introduced into the sac, or one alone. That which is connected with the positive pole produces a much firmer clot than that from the negative, and is consequently to be preferred, while the large copper electrode attached to the negative pole is placed at a convenient spot on the surface of the body. The needle should be insulated in such a way that the integument and the true wall of the sac are protected against

[1] Thesis, *Jahresbericht*, 1876.

[2] *Bull. de l'Acad. de Méd.*, 1888, xx. p. 224.

the caustic effect of the current. The recommendations as to the strength of current and also the duration of its passage are vague or vary within pretty wide limits. In but very few of the cases does a galvanometer seem to have been used, so that accuracy is not easy of attainment. DeWatteville[1] says the intensity should not exceed 20 to 30 milliampères, nor the duration of the first sitting surpass half an hour. Dujardin-Beaumetz,[2] no longer, according to Potain, as warm an advocate of the method as he was, advised an intensity of current reaching 54 on the Gaiffe galvanometer, and ten minutes as the maximum length of sitting, lest the needle be oxidized and possibly broken on withdrawal. Petit[3] has collected 114 cases of thoracic aneurism treated by electrolysis, with relief in 68. He thinks that his analysis shows a greater probability of relief when the procedure is resorted to before the development of an external tumor. We will not occupy space with a table showing the duration of the improvement attributed to the treatment. That the results are really not encouraging seems to be pretty clearly shown by the fact that comparatively few cases have been reported during the past ten years, by the tone of the discussion at the Medical Society of London,[4] and by the article of Potain.[5]

Still, it is fair to state that there are cases of which two of Richter's[6] may be taken as samples: An engineer of a water company, whose calling involved such severe muscular work as climbing cañons, was treated by electrolysis for a thoracic aneurism in 1884. Four and a half years later, though he still followed his occupation, the original aneurism was well, but a second had developed somewhat higher up. This was treated in the same way, and the patient returned to work. An innominate aneurism in another patient was similarly treated, and also, it is stated, with success; but death followed six and a half months later from tracheal pressure, causing suffocation. Richter thinks that the fatal result was due to a new aneurism, not to extension of the old. It has been remarked that aneurism seems to be common in California.

In comparison with these cases may be cited those mentioned by Bristowe,[7] one patient working for ten, another for three years, with no treatment but occasional rest.

Ralfe[8] claims for galvano-puncture (*a*) prolongation of life in rapidly progressive cases; (*b*) relief of pain, undue pulsation, and paroxysmal cough; (*c*) the probability of an almost painless death,

[1] *Medical Electricity*, N. Y., 1884, p. 200.
[2] *Bull. gen. de Thérapeutique*, 1880, p. 1.
[3] *Progrès Méd.*, 1880, p. 690.
[4] *British Med. Journal*, 1889, ii. p. 1336.
[5] *France Méd.*, June 3, 1890.
[6] *Pacific Med. and Surg. Journal*, May, 1888.
[7] *British Med. Journal*, 1889, ii. p. 1336.
[8] *British Med. Journal*, 1888, ii. p. 1162.

owing to slow oozing from the thickened sac, instead of sudden rupture, which if it occur internally must be extremely painful for a short time.

Others have found the method to be provocative of pain.

Another method of using electricity is that of Galeazzi and Vizioli —the external application of very strong currents, the positive pole on the aneurism, the negative on some indifferent point. The number of cases thus treated is small, but the method would seem to be worthy of further trial, especially as it is apparently free from some of the strong objections which are to be urged against the more radical electrical procedures.

The introduction of foreign bodies into the sac, as a method distinct from acupuncture, was first practised by Moore in 1864. From a few inches to seventy-five yards of metallic wire, watch-spring, horse-hair, catgut, silken or sea-tangle threads, have been passed into aneurisms since then. In 1879, Corradi, and subsequently a few others, extended the method by the addition of galvanism—an addition which does not seem to have proved valuable. In what follows no distinction will be drawn between those cases in which galvanism was used and those in which it was not. There is little or nothing to add to the communication of Verneuil,[1] made to the French Academy of Medicine in 1888. He collected 34 cases in which the operation had been done, subjecting them to a rigid analysis. The conclusions of this eminent authority carry all the more weight in that he is a surgeon, and consequently not prejudiced against operative interference. In 18 of the cases the thoracic, in 4 the abdominal, aorta was the seat of the aneurismal dilatation; in 1 case the arch and innominate, in 1 the subclavian, and in 1 the femoral (*inguinale*) was involved. In 2 cases cure is reported. The more important of these is that of Morse[2] of San Francisco, who cut down on a traumatic aneurism of the abdominal aorta, and then introduced the wire, the patient being discharged from hospital eight weeks later apparently cured. His subsequent history is not known to the writer. The other case of cure was a man of twenty-two with aneurism of the brachial artery, probably easily curable by other means. In many cases the operation was directly fatal. Verneuil acutely observes that apparently imminent external rupture of the sac is a rather weak point on which to base a decision to operate. As a matter of fact, external rupture is a rare exception, and it is well known that cases in which such rupture *seems* imminent often live on for weeks or months, and then die from internal bleeding, or even from exhaustion. He also shows that in some cases, without manifest

[1] *Bull. de l'Acad. de Méd.*, 1888, p. 18.

[2] *Pacific Med. and Surg. Journal*, 1887, xxx. p. 65.

urgency, resort was had to operation before adequate trial was made of milder means. In short, he concludes that the operation under discussion is a failure alike with reference to palliation or to cure, and that its results are far less favorable than those of other surgical, or even medical, methods of treatment. He thinks abdominal aneurism less ill-suited to filipuncture than any other. These utterances of Verneuil were in reply to Lépine, and have been dwelt upon here as based on the largest collection of cases and the most careful analysis.

Macewen's Method.—Macewen[1] has recently reported 4 cases which he has treated by a new method. Under antiseptic precautions a pin tapering to a point like a sewing needle, as fine as is consistent with strength and long enough to transfix the aneurism completely, is passed through the sac until it comes in contact with the other side. The pin is then to be moved over the surface of the inner wall, so as to irritate it, for ten minutes; next another point is to be similarly scratched without removing the pin, and so on until the larger part of the sac-wall opposite the seat of puncture has been acted on in a methodical manner. In some cases puncture from various sides may be necessary. The pin should never remain more than forty-eight hours in the aneurism, and it is questionable whether all the advantages may not be won in a few hours; but its retention for twenty-four to thirty-six hours seems to produce a greater immediate effect. As a rule, distinct thickening of the aneurismal walls follows at an early period, though it may require weeks. The operation is not painful, and should be repeated as often as seems necessary.

The Distal Ligature.—A century ago Brasdor suggested the distal ligature for aneurisms so seated that it is impossible to tie between the heart and sac. As applied to thoracic aneurisms, the operation consists in the ligation of the great trunks arising from the arch, the carotid and subclavian, singly, consecutively, or simultaneously, while the aneurism must be of the ascending or transverse aorta or of the innominate. The sac is still exposed to the blood-pressure, though perhaps to a less degree; but thrombosis may extend backward from the ligature to the sac. Rosenstein[2] and Scheele[3] agree in the opinion that this operation has yielded better results than any other surgical procedure. The former has collected 32 simultaneous operations done since the introduction of antiseptic methods. Of these 14 lived one year or more, during which time they were able to work; 5 were greatly improved; 5 not benefited; and 8 died within a week. Similar but less good results have been won by the consecutive, and even by the single, ligature. Scheele says that sacculated aneurisms of the innominate

[1] *British Med. Journal*, Nov. 15 and 22, 1890.
[2] *Am. Journ. Med. Sciences*, Jan., 1891.
[3] *Therapeutische Monatshefte*, 1888, ii. p. 1.

are those in which the operation is likely to be of service. It may safely be stated as a general law that sacculated aneurisms offer a better chance to treatment of any kind, but the degree of sacculation can rarely be determined with much accuracy. For obvious reasons a traumatic origin renders one more willing to interfere than an origin in syphilis or atheroma.

Manipulation of the sac, as suggested by Sir. W. Ferguson for peripheral aneurisms, and also the injection into the sac of coagulating materials, are not methods which can be recommended for aneurismal tumors of the aorta.

If one can condense the results of the operative and electrical treatment of aortic aneurism into a few words, it must be confessed that they are thus far discouraging, and that the methods do not seem to be growing in favor. It seems questionable whether the successes attributable to these methods are proportionally more numerous or greater than follow simpler treatment. We must remember that some cases do remarkably well with little or no treatment, and that spontaneous cures are not absolutely unknown.

Dissecting aneurisms of the aorta and its main visceral branches are not amenable to any treatment except the administration of opiates.

Diseases of the Veins.

Phlebitis and Periphlebitis.—Inflammation within or about the veins—phlebitis and periphlebitis—is not properly to be discussed apart from venous thrombosis, its concomitant or antecedent. A frequent cause of phlebitis being the extension of neighboring inflammation, the prompt and intelligent treatment of such inflammation is the best prophylactic—early evacuation and skilful subsequent management of abscesses, removal of foreign bodies, etc. Varicose veins are liable to inflammation, and certain individuals, perhaps those of a gouty tendency, seem especially predisposed thereto. Phlebitis is a not uncommon sequel of the severe and long-continued infectious diseases, notably typhoid fever; also of parturition. We recognize, of course, that phlebitis is often an important factor in the healing of wounds, and a barrier against the entrance into the circulation of toxic agents or principles—a danger which is to be guarded against by the strictest possible antiseptic precautions. In the prophylaxis of the other main danger of phlebitis, embolism from the detachment of the clot or a portion thereof, absolute rest is the all-important thing. Until, therefore, the clot in the affected part has become absorbed, or so well organized that there is no risk of its passing into the blood-current, rest is to be maintained while direct pressure on the vein is avoided, and such a position is secured as favors the return of venous blood through collateral channels. The application of moist

heat, the most convenient form of which is the poultice, certainly allays local pain and seems distinctly to promote reparative processes. Friction near the seat of inflammation should be avoided, but may be of service below if applied in the direction of the venous flow. Leeches and ice along the course of the affected vein are said by some to be useful, but the writer has no experience with them in this condition. The bowels are to be kept free. The choice of diet and the administration of stimulants are to be governed with reference to the state and constitution of the patient, rather than to the phlebitis. Pain may be sufficient to demand laudanum locally or an opiate internally.

If the clot is absorbed or the affected vessel is small, the circulation is promptly re-established. But if an important trunk or a considerable number of vessels in the same territory have become impervious, subsequent swelling and more or less disability persist until other channels become adapted to the work. While this process is going on a certain amount of rest is to be preserved, and skilful massage may be of great use. The support afforded by an elastic bandage, preferably of flannel and cut bias, permits greater use of a limb and promotes recovery.

Suppurative phlebitis is a grave condition, and is to be treated locally as a pyæmia, as well as with full diet, stimulants, and tonics.

Varicose Veins.—Unduly *dilated or varicose* veins are most common in the legs, scrotum, and rectum ; but may be met with in any portion of the body, in the deeper tissues as well as in and under the skin. Here, again, individual predisposition seems to play an important part, a similar degree of blood-stasis being followed in one person by varix ; in another not. There is no doubt, however, that all causes which tend to prevent free venous return from a part tend also to produce varix. Thus an employment which involves standing for long periods, and also tight garters, especially if worn below the knee, are likely to bring out any weakness that may exist in the walls of the veins of the leg; habitual constipation and straining at stool are productive of piles ; long-standing portal congestion from whatever cause is followed by fulness of, and often hæmorrhage from, the superior hæmorrhoidal veins ; other illustrations will suggest themselves to the reader. Prophylactic measures in any of these directions are in order as far as is possible. The extremes of life are more free from the condition than its middle period. Atony of the surrounding tissues, which thus fail to afford proper support, may also be added as a cause.

The broad principles of treatment of the developing or developed condition are clear and simple. Causes are to be removed as far as may be, though they may have been so long in operation that even after removal their effects persist and admit of only palliative treatment.

Varicosities of the legs may, in their early stages, be cured, much benefited, or, at all events, kept from getting worse, by rest in combination with other methods. If the recumbent position can be maintained for a few weeks, so much the better: if it cannot, as large a measure of rest as possible is to be secured at first. Walking is less deleterious than standing, the muscular contractions favoring the return of blood against gravity. Upward friction and well-applied massage are valuable adjuvants. If exercise is taken or walking is necessary, elastic pressure should be evenly applied before the horizontal position is quitted, and not left off until the legs are again raised to the level of the body. Circumstances must determine whether the pressure is to be obtained from an elastic stocking, from a rubber bandage, or from a flannel bandage cut bias. The pure-rubber bandage is a somewhat dangerous thing to put in the hands of a patient, who is apt to apply it too tightly and thus obstruct the circulation. When it is used a layer of cotton batting should intervene between the bandage and the skin, in order that moisture may be absorbed and maceration of the skin prevented. The general condition of the patient should receive careful attention, the diet being made more or less generous, and stimulants being given or withheld according to the requirements of the particular case. The bowels are to be regulated, in free livers at least, preferably by salines. In cases of marked local varix a pad of cotton or lint may be firmly fixed by strapping with adhesive plaster. Rupture of a vein, sometimes proving fatal from loss of blood, the patient being, perhaps, far from medical or skilled attention, requires local pressure and elevation of the limb.

The cases in which a cure is effected by the foregoing methods are not numerous. Many people go about without any mechanical support, but with a considerable degree of varix, and suffer little or not at all for a long time; or they may have more or less weariness or pain, generally dull, in the legs. The condition is, however, apt to get worse more rapidly when thus let alone. The palliative treatment is troublesome and must be persisted in for years; but sufferers become gradually accustomed to this as to many other chronic ailments, and do not very often demand an operation for radical cure. The use of caustics with the aim of producing inflammation and obliteration of the dilated trunk is now obsolete. Another and better means of securing the same end is by passing needles behind the vein, and then winding silk, rubber, or wire about them. Subcutaneous ligature of the vein is well spoken of, and excision of a portion of the vein has also given good results. For details as to these and other strictly surgical modes of radical cure the reader is referred to standard surgical works.

The treatment of hæmorrhoids is considered in the article on Diseases of the Rectum and Anus, Vol. II. of this System.

Raynaud's Disease.

Vascular spasm is supposed to be the immediate cause of this affection, which is therefore classified here under diseases of the blood-vessels. The cause of the spasm is in most cases extremely obscure, and we are obliged to content ourselves with attributing it to idiosyncrasy. Malaria seems to be influential in some cases. Syphilis has also been thought to be a cause; but this disease would seem much more likely to produce impairment of the circulation through arteritis than through spasm. The relations of Raynaud's disease to hæmoglobinuria are of greater therapeutic interest than are its relations to scleroderma and peripheral neuritis: indeed, gangrene is the only feature of Raynaud's disease which can well be brought into close connection with neuritis. Cold and dampness are of etiological importance in some cases, as is shown by the fact that the affection is more apt to originate in the winter and spring. But it does not always do so, and Raynaud[1] speaks of a Central American gentleman who came to Paris for treatment without obtaining relief. The same observer notes that attacks do not come on while the patient is in bed.

It is not in our power at present to prevent the disease, but something can be done to ward off the attacks in those known to be predisposed, by avoidance of chill and by warm clothing. Persistent galvanism and friction are also probably of value, and Barlow[2] relates a case in which the disease was kept in abeyance for two years by this means. Finally, the patient became weary of the treatment and abandoned it; severe gangrene followed by lymphangitis set in, and it was necessary to amputate the thigh. If attacks are repeated at short intervals, there is hope that by remaining in bed the liability may be overcome, at least for a time. Unfortunately, the disease seems to affect by preference classes of the community, feeble women and children in poor circumstances, who are unable to follow out prophylactic measures to the full. Between attacks patients should exercise in suitable weather as much as they can.

In the treatment of an attack it is our aim to try to restore free circulation as quickly as possible, thus alleviating the pain, which may be very severe, though it is sometimes absent, and diminishing the danger of consecutive gangrene. In mild cases it may be sufficient to wrap the part in cotton and place it near the fire. If tenderness is not too great, friction is to be used, but is not tolerated in the earlier stages of severe cases. In such, warm applications and galvanism are the best remedies. It is true that Southey found an ice-bag more grateful than warmth in one of his cases, but Raynaud has seen painful recru-

[1] *Selected Monographs*, New Sydenham Society, 1888.
[2] *Ibid.*; also *Illustrated Medical News*, April and May, 1889.

descence after the cessation of cold irrigation. He also warns us against the use of such a decided rubefacient as mustard.

Galvanism was first used to the spine by Raynaud, with the idea of acting on the vaso-motor centres, but it is found that direct application to the limbs is more efficacious. Barlow advises immersion of the affected limb in salt and water with one pole of the battery, while the other pole is moved about on the skin above the level of the water. "The current should be rapidly reversed, made, and broken, and the patient should be encouraged to make voluntary flexion and extension movements of the limb during the time it is being galvanized." A change in hue from purple to pink shows that restoration is taking place, and galvanism should be kept up till this change is complete: friction can then generally be borne, and the patient should be urged to practise this himself. Another method of applying galvanism is by "painting" the limb with the current, the poles being placed quite near each other. Lamp, vapor, and Turkish baths are also recommended. The occurrence of limited gangrene should not prevent a continuance of electricity above the affected area.

Mild cases of gangrene can safely be left to themselves, but major degrees may demand surgical interference—even amputation when the deeper tissues are seriously involved.

Internal medication has thus far proved nearly valueless in this disease, if we may except opiates for the relief of pain. A sufficiency of good food is important, and it may be desirable to give such remedies as tend to promote appetite and digestion, and also general tonics. The apparent close connection with vascular spasm naturally suggests the use of the nitrites, which have been repeatedly pushed to the point of headache and flushing of the face without producing the slightest change in the affected parts.

DISEASES OF THE BLOOD.

By FREDERICK C. SHATTUCK, M. D.

Anæmia.

Some consideration of etiology must necessarily precede the attempt to describe the treatment of any affection—a statement which is particularly true of anæmia, so common and widespread in its several forms, so often merely a symptom or result of some underlying local or general cause.

Our knowledge is not yet sufficient to enable us to make a perfectly satisfactory classification of the causes of anæmia. Perhaps that which is usually employed for clinical purposes is as good as any—into the two great divisions, namely, of primary and secondary anæmias. With increasing knowledge the primary class is likely to grow smaller, but it includes all those anæmias dependent on a cause or causes, to us unknown, acting directly on the blood itself, on the blood-forming organs, or on both at once. We have no right, therefore, to class an anæmia as primary until we have carefully excluded all causes, whether local or general in character, to which the condition may reasonably be attributed.

It is more convenient to take up the secondary anæmias first, and to set forth their most frequent causes, although it is true that in these cases we must sometimes treat the anæmia symptomatically, either because the cause is wholly or partly irremovable or in recognition of the well-known facts that disease often works in a circle, and that, in biology at least, the effect does not always disappear on the removal of the cause.

Secondary Anæmia.—Among the chief causes of anæmia are the following:

1. *Hæmorrhage.*—Hæmorrhage whether single and profuse, or more or less trifling, but persistent. Obviously, the indication is to arrest the blood-loss, success in meeting which will ordinarily be followed by a rapid restoration, first, of the plasma, somewhat less promptly of the red corpuscles. Either class of hæmorrhage may, however, in rare cases apparently produce such an effect on the blood-forming organs themselves that they are unable to make good the loss.

The feeble cardiac action on which syncope indirectly depends may

bring about cessation of a profuse hæmorrhage, and circumstances must then determine whether it is desirable to do more than secure absolute rest, with such precautions against the recurrence of the bleeding as its nature and seat suggest. It is estimated that a person can stand a single blood-loss of at least a third of its total volume without a directly fatal result, perhaps with a surprisingly rapid recovery. If the patient does not show signs of rallying from the collapse following hæmorrhage the question naturally arises of artificially supplying in greater or less measure the loss sustained. A simple and ready means of stimulating the circulation is the application of heat internally by a rectal injection of a quart of warm saline solution, externally by hot bottles, some form of alcohol being given by the mouth if the patient can swallow. Or a sterilized solution of common salt, 0.6 or 0.7 per cent., can be thrown into a vein, into the subcutaneous tissue, or into the peritoneum. It has been and is maintained by some that such a saline solution is just as potent to save life as is the transfusion of pure or defibrinated blood, while it is free from some dangers incident to the latter procedure. Landois[1] and others, however, hold that the most which a saline solution can do is somewhat to delay death, basing their conclusions partly on general principles, but chiefly on the results of experiments on animals. Such cases as that of Whitwell[2] of San Francisco, who apparently saved the life of a typhoid patient collapsed from intestinal hæmorrhage by the transfusion of whole blood after a saline solution had been injected into a vein without success, seem to bear out this view. But there are other and more numerous cases recorded in which the saline solution seemed certainly to save life, though it is possible to assert in these that recovery would have ensued without its use. The last word has probably not been said as yet on this question.

Transfusion of blood may be made either directly or indirectly. In the former case it is most easily done with the aid of an Aveling syringe, which consists of a rubber tube having a small bulb in the centre, and with metallic extremities fitted with stopcocks. A canula or hollow needle is to be attached to either end. The arms of the patient and the giver of the blood are placed side by side, and at the same time that the surgeon opens the most prominent vein in the patient's elbow an assistant opens one in that of the giver. The canulas, previously filled with water, are introduced, the point in the former being directed toward the body, in the latter toward the hand, and connected by means of the syringe, which is filled with tepid water or a weak salt solution to displace the air, and the stopcock closed. The cock on the patient's side is then opened, and the contents of the bulb

[1] Eulenburg's *Real Enclycopædia*, vol. xx. 2d ed., Article "Transfusion."

[2] *Pacific Med. and Surg. Journal*, April, 1886.

slowly injected. The bulb is refilled by closing the cock on the side of the patient and opening that on the side of the donor, and the process is repeated till enough has been introduced, when the canulas are removed and the wounds dressed as after venesection. The chief dangers to be avoided are sepsis and the introduction of air.

In mediate transfusion several methods have been employed: in one the donor is bled directly into a syringe, the piston being withdrawn; the piston is then replaced and the blood injected into the patient's vein. Rapidity of execution is essential to prevent coagulation, and not more than two minutes should elapse between the receiving and delivery of the blood. For intravenous injections of defibrinated blood, or a 0.5 or 0.6 per cent. solution of salt, all the apparatus required consists of a glass funnel, some rubber tubing, and a canula, the rapidity of the flow being regulated by raising or lowering the funnel. According to Mayet,[1] if the median basilic be selected, the amount should be about an ounce per minute, though not much harm is likely to arise if ten ounces be injected in six minutes; and this should generally be the maximum quantity except in cases of extreme urgency, in which the relative emptiness of the vessels is the chief source of danger. The same simple apparatus is also sufficient for the subcutaneous injection of salt solution: from 500 to 1000 c.c. (17 to 33 ounces) may be injected beneath the skin of the back or the axillary region, absorption being aided by gentle massage. Should the skin become too greatly distended, a second injection can be made. This method of rapidly making up a deficiency in the quantity of the circulating liquid is free from danger, can be easily done without trained assistance, and in many cases in practice has been successful.

Ziemssen has largely practised another method which seems to be at least safe—namely, the subcutaneous injection of defibrinated human blood. His first results were not satisfactory, but after an interval of nearly ten years he has lately resumed his work in this line, and has now so perfected his technique as to avoid all undesirable effects and obtain marked benefit. Strict antiseptic precautions are observed throughout the operations of drawing and injecting the blood, which is done under the skin of the thighs. He uses a syringe containing 25 c.c. (6.7 drachms), the contents of which are thrown slowly into the tissue, while an assistant puts his "full strength" into massage of the part, so that the blood is diffused widely and thus put into a favorable condition for rapid absorption. From six to fourteen syringefuls are injected at a sitting, the patient being under anæsthesia, as the injection and the massage are alike painful. If no more than 50 to 100 c.c. (1.6 to 3.3 ounces) is injected,

[1] *Lyon Méd.*, May 10, 17, and 24, 1891.

the patient can leave his bed the next day; if larger quantities, the soreness is likely to keep him quiet five or six days. In cases of great urgency a salt solution should first be injected into a vein, thus furnishing the heart bulk on which to act until the corpuscles contained in the subcutaneous blood injection can reach the circulation and supply that which is needed for permanent recovery. An obvious objection to this method in urgent cases is the necessity for anæsthesia.

2. *Loss of the Albuminous Constituents of the Blood.*—Anæmia which is dependent on loss of the albuminous constituents of the blood, as in lactation, Bright's disease, prolonged or profuse suppuration, watery diarrhœa, and the like, may often be treated symptomatically with advantage, but we must strike deeper if we hope to accomplish notable or lasting results.

3. *Inanition.*—A large class of anæmias is attributable to *inanition*, dependent on a single, or a combination of many, causes. Among these may be mentioned defective hygiene in one or many elements —unfavorable surroundings; insufficient or inappropriate food; and lack of power, from local or general causes, to take or assimilate food, however suitable or easily attainable. In this class are included all those numerous cases of gastric disorder in its many and varied forms. These causes are rarely single, but are met in every variety of combination; each class in life, each occupation or trade, each sex, and the different periods of life involving more or less peculiar liabilities to innutrition anæmia. There would be no difficulty in filling pages of this work with illustrations of these causes in detail, were it necessary or desirable to do so. Of course it is often quite impossible to remove the single or combined causes. Fortunately, however, man is a wonderfully adaptable animal, and manages to accustom his organism to very unnatural, even to deleterious, influences. The breaking up of some bad habit—masturbation, excess in tea, coffee, or tobacco, insufficient sleep—the intelligent treatment of impaired digestive power, or a change of dwelling-place may be followed by recovery though the mode of life of the patient is still far from ideal in many other respects. A word should be said as to the association of atrophy of the gastric tubules with grave anæmia. We know that the two are sometimes coincident, but it is not clear that the tubular atrophy is primary. We have been led to believe in recent years that the importance of the stomach is less paramount for digestion than was formerly thought, and that intestinal digestion may be sufficient to maintain life for long periods.

4. *Toxæmia.*—The toxic anæmias fall into two subdivisions: first, those in which the continued absorption of a mineral poison is the causative agent, lead, mercury, arsenic, and phosphorus being specially referred to here. In potassium iodide we possess a valuable means of

freeing the lead stored up in the tissues in an insoluble form. The dose should not exceed 10 grains thrice daily, and J. J. Putnam, who has given much attention to plumbism, particularly in its nervous manifestations, and to its treatment, believes that the drug acts better when given for a few weeks, omitted for a like period, and so on. There is thought to be danger of producing cerebral symptoms if large doses are given at first and relatively considerable quantities of lead are thus poured out rapidly into the circulation. Warm baths and laxatives are held to be promotive of the elimination of the metal. Essentially the same means are recommended for the expulsion of mercury as for lead. It is not probable that we can directly influence the elimination of arsenic and phosphorus.

The second sub-class of toxic anæmias includes those dependent on syphilis, malaria, intestinal parasites, and perhaps myxœdema: if the view of Sir Andrew Clark is correct, his fæcal anæmia also belongs here, constipation favoring in some persons the development of principles in the alimentary canal which, by being absorbed into the blood, act deleteriously on that tissue itself or on the organs which play the chief parts in its formation. The anæmia of syphilis and malaria demands general tonics and change of air in addition to the specific treatment appropriate to each of these diseases. It should be firmly fixed in the mind that direct antisyphilitic remedies alone often fail, but succeed when combined with measures skilfully addressed to the general state.

Griesinger showed the dependence of Egyptian chlorosis on the anchylostomum, but it is only in recent times that the attention of the profession outside the tropics has been strongly directed to intestinal parasites—the tape-worm, especially the *Bothriocephalus latus*, the *Tricocephalus dispar*, and, above all, the *Anchylostomum duodenale*—as causative of anæmia. The outbreak of anchylostomiasis among the workmen of the St. Gothard tunnel, at first deemed a peculiar anæmia, aroused great interest. Cases bearing all the marks of that form of anæmia called pernicious have been repeatedly cured by the expulsion of a tape-worm. Kynsey[1] shows that the beri-beri of Ceylon, which is never followed by paralysis, is really a secondary anæmia traceable to the anchylostomum. Erni[2] in upward of fifty autopsies on beri-beri patients in Sumatra has never failed to find the lesions of the tricocephalus or the anchylostomum, which, he says, are not found in patients dead from other diseases. There is doubtless here an important field for further study, and it is certainly desirable to remember that intestinal parasites, either by the abstraction of blood or through the absorption of some ptomaïnes, the formation of which is

[1] *Report on Anæmia, or Beri-Beri, of Ceylon*, Columbo, 1887.

[2] See p. 53 of Kynsey's *Monograph*.

or may be a concomitant of their life in the body, may be at the bottom of an anæmia which proves rebellious to ordinary treatment.

The eggs of the parasites should be carefully searched for in the stools of such a patient. If these are found, the species of worm is then known as well as the particular anthelmintic which should be administered. The examination of fæces is not, however, an attractive field in which assistants delight to wander; and one should not, therefore, rely implicitly on a negative report in obstinate cases: a series of anthelmintics can do no harm if properly given, and may complete the diagnosis and cure the patient at one and the same time.

The fæcal anæmia of Clark reminds us of the long-standing use of laxatives in anæmia and of the statement made, I believe, by Hamilton of Dublin long ago, that were he compelled to choose between chalybeates and laxatives in the treatment of anæmia, he would select the latter. The discovery of ptomaïnes and leucomaïnes seems to give justification for the faith which was in many, and has also thrown important light on the function of that large and mysterious organ, the liver, which stands between that portion of the body where putrefactive change is normally going on and the general circulation, and is charged with the duty of splitting up the toxic agents formed in the intestines, absorbed into and passed along the portal system.

The anæmia which often accompanies or follows the acute infectious diseases, as well as such chronic affections as tuberculosis and cancer, is probably of mixed origin in most cases, inanition, hæmorrhage, changes in the plasma, and toxæmia being factors in varying degrees in different cases. Careless practitioners sometimes find out when it is too late for their own reputations, as well as for the interests of their patient, that an anæmia which is guessed by them to be simple was really underlain by tubercle or cancer.

Primary Anæmia.—We are now come to the consideration of those anæmias which for the present we must remain content to class as *primary* (having first excluded all probable causes external or internal to the individual affected), and the treatment of which must therefore be symptomatic rather than causal. For clinical purposes we can distinguish three forms of primary anæmia: 1st, simple anæmia, 2d, chlorosis, 3d, pernicious anæmia.

1. *Simple Anæmia.*—Anæmia is to be prevented by a life of "hygienic righteousness," to use the expression of the late Dr. George Derby of Boston. Such a life is, however, obnoxious to most of us, and we prefer to take our chances, believing, as often proves true, that there will be time for repentence and reform before irremediable damage is done. The cases in which we have, perhaps, the best opportunity for preventive treatment are those of delicate

children, the rearing of whom should be intelligently supervised, especially if they come of families predisposed to anæmia, phthisis, etc. A country life, with a change to the seashore during a portion of the year, or *vice versa;* proper sleep and food; suitable clothing; bathing with water at as low a temperature as permits prompt and lasting reaction; such an amount of exercise, and no more, as trial shows to be well tolerated,—these are some of the important things to be secured. It may be found that the stimulant action of cold water on the skin can be gained in the following, if in no simpler way: On rising the skin is to be rubbed with a dry and roughish towel—the hand of the nurse may be used for a child; a cup of hot nourishment is then to be taken; next, the person sits in the tub with a few inches of warm water and dashes or has another dash a large pitcher or pail of water at about 60° Fahr. on the neck, and is then vigorously rubbed dry. This is a plan recommended by Dr. Eustace Smith, and has been found by the writer to act well. The wisdom of the parent counts for as much as the skill of the physician. In children of both sexes masturbation is often overlooked, it being taken for granted that a child is too young for such practices, or it being thought undesirable to "put ideas into its head." The writer's experience inclines him to believe that the profession would do well to call the attention of parents to this danger more frequently than is done.

A deficient appetite or feeble digestion must be stimulated or reinforced in accordance with well-known principles, into which we cannot enter here in detail. The Weir-Mitchell plan of treatment is especially adapted to those cases in which nervous exhaustion is an accompaniment of anæmia. Massage and electricity without seclusion and forced feeding, or various combinations of these methods, may be sometimes employed with advantage.

The drug which general professional experience has shown to be of perhaps most service in simple anæmia is iron. Some experimenters tell us that the amount of iron which is absorbed into the blood is infinitesimal. Hamburger,[1] for instance, recovered from the fæces of dogs nearly all the iron administered to them by the mouth. That this result is not to be explained by the excretion into the intestine of the iron after absorption into and circulation with the blood seems to be shown by the experiments of Jacobi,[2] who injected iron into the blood-vessels of dogs and rabbits. He found that about 10 per cent. is excreted by the bowels, liver, and kidneys together; about 50 per cent. is deposited in the liver; the rest in the spleen, kidneys, intestinal walls, and other organs: it is all removed

[1] *Zeitschrift für Phys. Chemie*, 79 and 80.

[2] *Arch. für Experimentelle Path.*, xxviii., 1891.

from the blood within two or three hours after administration. The foregoing investigations were made since the publication of the seventh edition of Wood's *Therapeutics*,[1] in which a foot-note states "The subject of the absorption of iron urgently needs reinvestigation." The note might stand unchanged to-day. Exactly how iron acts we do not know, but we do know that it is an important constituent of hæmoglobin, and we have the strongest clinical evidences of its usefulness in anæmia, especially in those cases in which the hæmoglobin is relatively more diminished than the number of red corpuscles—chlorosis.

There is no one preparation of iron which meets all cases equally well, and it is fortunate that we have a large number of pharmaceutical compounds and natural mineral waters from which to select. The latter may be dismissed with the statement that the great advantage of drinking them at their sources lies in the more easy enforcement of general hygiene: the intrinsic merit which they possess is the dilution of the metal, and its consequent greater acceptability to some stomachs. A coated tongue with feeble digestion and constipation are held, and generally justly, to be contraindications to the use of iron, the way for which must then be prepared by the vegetable bitters, mineral acids, pepsin, and laxatives. Orexin hydrochlorate has been recently recommended by Penzoldt[2] as a stimulant to the appetite and digestion in early cases of phthisis, chlorosis, and anæmic conditions. It is to be given in doses of from 5 to 10 grains, either in dilute aqueous solution or in pills. Müller[3] has not found it useful, but Gordon[4] speaks highly of its effects in scrofulous children. Most ferruginous preparations are more or less constipating, and it is therefore often desirable to combine the iron with a laxative—aloes, for instance—or to give the latter separately. There seems to be some doubt whether the proto- or the per- salts are the more readily absorbed, but it is not likely that solubility of a salt in water offers any advantage, the acid gastric juice precipitating most of the metal. It is stated that large doses of iron are less constipating than small ones, in that the former stimulate peristalsis. It does not seem worth while to enumerate or discuss the merits of the different preparations: each practitioner has his favorite or favorites. Perhaps the tincture of the chloride is more used than any other liquid form of iron; the sulphate, carbonate, and citrate than any other solid preparations. It is better to give too much than too little, especially if the large doses are less constipating.

The hypodermic injection of soluble iron preparations, of which the lactate, the salicylate, the albuminate, and the double citrate of iron and ammonia are the least irritating, has been practised by some. The only experience the writer has with this method is in one case of per-

[1] P. 474.
[2] *Therapeutische Monatshefte*, 1890.
[3] *Ibid.*, later No.
[4] *Lancet*, 1891, ii. p. 68.

nicious anæmia with great gastric irritability. It is true that iron does not usually prove useful in these cases, but other remedies failed, and dialyzed iron was injected. No abscesses were formed, but at the autopsy so much iron was found in indurated lumps at the site of the injections that it would seem that little if any could have been absorbed.

Arsenic is a remedy of great power, and can be given alone or in combination with iron. Manganese is believed by some to be useful. The phosphate of lime, usually given now-a-days in the form of the compound syrup of the hypophosphites of lime, sodium, and potassium, with or without the addition of iron, quinine, and strychnine, is much given, and is probably especially useful in the anæmias of the period of active growth, of lactation, and the like. Cod-liver oil, if well borne by the stomach, is very useful in scrofulous and some other anæmias; and the favorite form of iron in these cases is the iodide. A mixture of the syrup of the iodide of iron and cod-liver oil is an inelegant mess, but commends itself to many dispensary patients.

Anæmia being associated with deficient oxidation, due partly, no doubt, to diminution in the number of red corpuscles, as well as in the hæmoglobin, it is natural that one should think of the possibility of artificially supplying oxygen by means of inhalation or by the drinking of distilled water saturated with the gas. With regard to the usefulness of oxygen inhalations there has been and is much dispute among physiologists and clinicians alike. One party denies the possibility of adding to the oxygen of the blood by any such means, which, at the most, is nothing more than pulmonary gymnastics: among these may be mentioned Ewald[1] and G. L. Peabody.[2] A second party maintains the exact opposite, its members differing only in the degree of value which they attach to the inhalations: this side is well presented by Ephraim.[3] Aune[4] is satisfied that he has observed increase both in the number of red corpuscles and in hæmoglobin in healthy persons. Hayem[5] is convinced that oxygen inhalations improve the appetite, digestion, and general condition of chlorotics, increasing the number of red cells, but not the hæmoglobin, and rendering it possible in many cases to give and derive benefit from iron, which without the oxygen may not be tolerated. The effect of the inhalations alone he finds temporary, patients falling back when they are discontinued. The value of oxygen, therefore, in his opinion, is as an adjuvant to other treatment: Doreau[6] shares his view. Albrecht,[7] as a result of his experi-

[1] *Handbuch der Allg. und Spec. Arzneiverordnungslehre*, Berlin, 1887.
[2] *Med. News*, May 25, 1889.
[3] "*Ueber Sauerstoff—Therapie*," *Berliner Klinik*, Feb., 1890.
[4] *Thèse de Paris*, 1880.
[5] *Gazette de Paris*, 1881, p. 21.
[6] *Thèse de Paris*, 1881; Virchow, Hirsch, *Jahresbericht*, 1881.
[7] *Jahrbuch für Kinderheilkunde*, N. F. Bd. 18.

ence with fifty convalescent but anæmic children, believes that oxygen increases both corpuscular richness and hæmoglobin, improving at the same time appetite and digestion: he says nothing to indicate that these good effects were only temporary. Jaccoud[1] and Dujardin-Beaumetz[2] are also among the adherents of the use of oxygen in anæmia. A third party preserves a cautious neutrality, not denying the possibility of usefulness, but holding it to be doubtful or very slight. Among its members may be named Nothnagel and Rossbach,[3] and Oertel.[4]

Perhaps this oxygen controversy affords as fair an illustration as any of the difficulties which are often met in approaching a therapeutic question from the physiological and experimental side. Experimental evidence must be very strong to warrant us in absolutely throwing over clinical evidence: there is plenty of room for error in both. Practically, however, the number of cases of simple anæmia and chlorosis in which it is clearly our duty to resort to oxygen are few, inasmuch as we can generally gain our ends sufficiently well without its aid. Until the price of the gas is less than at present, its costliness alone must debar its use in many cases. The gas would seem indicated in cases of anæmia and chlorosis which prove rebellious to the more common methods, and in which for any reason it is impossible to secure an abundance of pure country or sea air. It is probably not a matter of much consequence whether the pure gas or that mixed with nitrous oxide is used: a smaller quantity than ten gallons three times a day is not likely to render much service. Oxygen has also been administered by enema.

Transfusion and its substitutes, which were spoken of under the head of acute anæmia from hæmorrhage, are seldom demanded in simple anæmia and chlorosis, though they have been practised. Ziemssen's method is the best—or least undesirable—of these, and he reports that in a girl of eight years the hæmoglobin nearly doubled within twenty-four hours after the subcutaneous injection of 50 c.c. (1.6 ounces). Blood-drinking in slaughter-houses has now gone out of fashion. Pastilles of hæmoglobin do not seem to have won general favor.

Boerhaave and Hoffman held that chlorosis is really a condition of plethora, and Emmerich was thus led, in a thesis published in 1731, to advocate repeated small venesections for its cure. This treatment has been revived by Scholz[5] of Bremen, who holds that the high arterial

[1] *La Semaine méd.*, Aug. 3, 1888.
[2] *Leçons de Clinique Thér.*, iii. p. 406.
[3] *Handbuch der Arzneimittellehre*, Berlin, 5 Auflage.
[4] *Handbuch der Respirat. Therapie*, Leipzig, 1882.
[5] *Die Behandlung der Bleichsucht mit Schwitzbädern und Aderlässen*, Leipzig, 1890.

tension long recognized as present in many cases of anæmia and chlorosis is primary, the changes in the cells and hæmoglobin secondary. In his earlier experience he combated the high tension by hot baths with gentle friction, and met with such success that he has persevered in this line of treatment. Of late years he has gone a step farther, supplementing the hot baths by venesection, and is satisfied with his results. Faye[1] reports two cases, one his wife, in which repeated small bleedings were successful. Wilhelmi[2] reports thirty cases of severe anæmia—some of which had failed to improve under iron and other drugs—successfully treated in this manner.

Enemata of fresh or dried defibrinated blood, the use of which was advocated by A. H. Smith,[3] are probably no more useful than nutrient enemata of other and more accessible ingredients; but there can be no question that the rectum may be forced into service with advantage in severe cases, particularly those in which gastric digestion is greatly enfeebled.

2. *Chlorosis.*—With regard to the treatment of chlorosis there is not much to add to what has been already said. Chlorosis, in its pure form, is practically peculiar to young females, and is furthermore distinguished from simple anæmia in that the number of the red corpuscles remains about normal, while the hæmoglobin is greatly diminished, the blood of anæmia showing decrease in both directions. If both are diminished, but the hæmoglobin in excess, the two conditions are said to be combined; and combined they not infrequently are. It is in chlorosis that iron scores its most brilliant successes, and it is gratifying to follow with the hæmometer the rapid increase in the hæmoglobin under the use of the drug, which should be given in large doses and continued for two months or more in combination with the best attainable hygienic measures. If Virchow's view as to the etiology of chlorosis were true, it is difficult to understand how the condition can be so transitory and curable as it generally proves. The arterial system can scarcely become deficient and again sufficient within relatively brief periods of time.

From what has been said above, the practical use of hæmoglobin estimations, as suggesting how far iron is indicated in any particular case, is obvious. Amenorrhœa is vastly more likely to be a result of anæmia and chlorosis than to stand in any causative relation thereto. As the blood and general nutrition improve, the menses reappear, and gradually regain their normal amount and character.

3. *Pernicious Anæmia.*—As the name indicates, pernicious cases do not hold out hopes of brilliant therapeutic success. And yet some cases which seem to be primary do recover: the prognosis is there-

[1] *Norsk. Mag. for Laegevidenskaben*, 1887, p. 821.

[2] *Berlin. klin. Wochen.*, 1891, No. 9.

[3] N. Y. *Med. Record*, July 18, 1878.

fore, though grave enough, less so than it was in the early days of our knowledge of this disease. Other cases improve very markedly for a time, perhaps apparently recover, but relapse and ultimately succumb. Some of the reported recoveries are surely illusory, and, if they had been longer followed up, would not have been classed as such.

In pernicious anæmia the percentage of decrease in the number of red corpuscles is ordinarily greater than that of the hæmoglobin, though the latter may fall as low as 20 per cent. The studies of Hunter and others afford ground for the belief that, certainly in some cases, the root of the trouble lies in increased blood-destruction rather than in deficient formation: indeed, it would seem that blood-formation may be unusually active, even in strongly-marked cases.

The cause of the affection being either unknown or beyond our reach, treatment must be practically symptomatic, with the general aim of restoring a true balance between hæmogenesis and hæmolysis, as far as possible. Hospital treatment is desirable for those of small or very moderate means, as in no other way can they obtain the minute attention to nutrition and the amount of attendance which they require. In a few cases change of air has proved beneficial, but ordinarily, if fair hygienic surroundings are obtainable at home, that is the best place. The stimulus to nutrition afforded by fresh air and sunshine is of great value. Keep the windows open and the shades up, therefore, as much as possible, remembering only that the circulation is apt to be feeble and to require the aid of hot bottles and plenty of blankets. Absolute rest is also of great importance, and the maximum amount of food should be given by the stomach and bowel. If notable diarrhœa or gastric irritability are features of the case, the problem of feeding is more difficult and the outlook more grave. Hunter[1] has seen gain appear first after the adoption of an exclusively farinaceous diet, and thinks that this may prove a valuable hint. A nitrogenous diet, according to him, causes in health much greater blood-destruction than a farinaceous one, probably from more readily leading to putrefactive changes in the intestine, which changes he thinks are perhaps the causative agent in the production of the increased blood-destruction characteristic of pernicious anæmia. The writer has for some years fed his cases of this kind with beef-juice, eggs, and milk to the limit of toleration of both stomach and rectum: he has seen no permanent recovery, though repeatedly very great temporary improvement.

Iron is less valuable than arsenic in this disease, though the combination of the two sometimes works better than the latter alone. Arsenic should be given at first in small doses, gradually increased toward the limit of toleration, and kept up for a long time after conva-

[1] *British Med. Journal*, July 5 and 12, 1890.

lescence seems to be established. In the case of a boy for a long time under the writer's care in the Massachusetts General Hospital last winter, a few drops of Fowler's solution after meals were soon followed by distinct general loss and fresh hæmorrhages: this occurred twice, and suggested the possibility that chronic arsenical poisoning might be the cause of his anæmia. But the urine contained no arsenic after that which was given him medicinally was eliminated. The only thing which seemed really to benefit this boy was the inhalation of oxygen, ten gallons thrice daily. The writer has in another case seen the number of red corpuscles and the hæmoglobin rise nearly to the normal from a very low point, with corresponding gain in the general condition under oxygen, for some time previous to the use of which the patient was steadily losing ground in spite of what seemed the best treatment. Later, relapse set in, and oxygen then failed to stay the downward trend.

The hope of benefit from transfusion and its substitutes must be extremely small. Arterial transfusion is said to have been successful in the experience of Quincke in one case.

Leucocythæmia.

The treatment of this disease is less hopeful than that of pernicious anæmia, certainly when it is sufficiently advanced to warrant a positive diagnosis. The etiology is very far from clear. Eichhorst[1] gives a list of widely-differing ailments which have been followed by leucocythæmia, and it is maintained by some that affections leading to chronic hyperplasia of the spleen and lymph-glands, as well as changes in the bone-marrow, are predisposing causes. If this be so, the prompt and thorough treatment of these conditions has prophylactic value. Osler[2] is inclined to think that chronic splenic tumor is more likely to be followed by anæmia than by great increase in the number of the white corpuscles. At all events, we are not acting against the interest of a patient with a malarial spleen if we do our best to cure him with quinine, arsenic, or other antiperiodics.

Mosler and some others report recovery under quinine, arsenic, iron, and other tonics in what they take to be the early stage of the disease —moderate splenic enlargement and increase in the leucocytes, with little or no involvement of the lymph-glands. Cold douches, faradization, galvanism, and inunction of biniodide of mercury ointment over the enlarged spleen have all been used in the hope of reducing its size, and thus combating the disease: it is more clear that the first result may be obtained than the second. The spleen has been excised a number of times, oftener than is likely to be done in the future if statistics

[1] *Handbuch der Speciellen Path. und Therapie.*

[2] Pepper's *System of Medicine*, vol. iii.

have any value. Injections of ergotin, iodine, Fowler's solution, etc. into the spleen and glands do not kill patients, but are not apparently useful.

Arsenic, phosphorus, iron, quinine, and general tonic and symptomatic remedies are those which, administered internally, seem to have yielded the best results. It must be remembered that oscillations in the number of the white cells and in the size of the tumors occur quite independently of treatment in some cases. Caution is to be exercised in the use of laxatives, in view of the troublesome diarrhœa which is sometimes a prominent symptom. Marked gain in all respects has promptly set in after oxygen inhalations. DaCosta[1] has given a hundred gallons daily.

Even in a work of the size of this it seems hardly worth while, merely for the sake of completeness, to enumerate all the unsuccessful therapeutic efforts which can be found in literature.

Pseudo-leucocythæmia.

The etiology of Hodgkin's disease is too obscure to give us any prophylactic hints, unless the first glandular swelling may originate in some long-standing irritation in the neighborhood. We know that in some cases the lymphadenomatous growth is pretty strictly limited to one, and perhaps an accessible, group of glands. Here it is probably our duty to call in the aid of the surgeon after a fair trial of medical treatment. But surgery is powerless if the disease has become generalized, except to relieve impending suffocation from pressure on the upper trachea. Local treatment of the glandular tumors, whether by inunction, injection, electricity, or other means, seems to be devoid of real value.

We are therefore limited in most cases to a symptomatic and general tonic treatment. At the head of the list of internal remedies arsenic should probably be placed. As in leucocythæmia, it should be begun in small doses, which are to be increased up to the limit of toleration, and there maintained for weeks or months. Phosphorus is said to have proved useful: there is no objection to trying the iodides and cod-liver oil. Spontaneous changes, similar to those observed in leucocythæmia, also occur here.

Melanæmia.

This condition occurs only in connection with chronic malarial poisoning, extensive melano-sarcoma, and, rarely, Addison's disease. The former demands energetic appropriate treatment; the two latter are beyond the reach of remedies.

[1] *Am. Journ. Med. Sciences*, 1889.

Hæmoglobinæmia.

Whenever destructive action is exerted on the red blood-corpuscles, more or less of their hæmoglobin is set free, and mild degrees of hæmoglobinæmia thus probably accompany many cases of the different forms of primary and secondary anæmia. But in these cases the amount of free hæmoglobin is so small, or it undergoes such changes, perhaps into bilirubin or other substances, that it neither appreciably colors the blood-serum nor escapes from the organism through the kidneys, giving rise to hæmoglobinuria. These mild degrees do not concern us here, and it is proposed to consider under this head only those cases in which the existence of hæmoglobinuria reveals the cythæmolysis.

There is one great class of cases in which the blood-destruction is wrought within the blood-vessels themselves—in which the hæmoglobinuria is clearly of systemic origin and a purely secondary manifestation. This class includes those cases which are traceable to the absorption into the blood of such chemical substances as sulphuric, muriatic, carbolic, and pyrogallic acids, chlorate of potassium, naphthol, nitro-benzol, arseniuretted hydrogen, and the like. The symptom also occurs in rare cases of the acute infectious diseases, as diphtheria, scarlet fever, and typhoid fever. It has been noted in connection with severe burns of the skin and sunstroke. Transfusion of the blood of another species of animal produces it. It is said to have been seen in the course of diseases characterized by hæmorrhage—scurvy and purpura for instance—though hæmaturia is here the rule. Finally, it is a prominent symptom in that peculiar and rapidly fatal infectious process in newborn children, marked furthermore by cyanosis and icterus, to which Winckel's name has been attached, though W. S. Bigelow[1] published in 1875 a full and accurate account of an outbreak which occurred in the Boston Lying-in Hospital during that year, thus antedating Winckel[2] four years.

In all of these conditions the treatment of the hæmoglobinæmia is that of the special cause which provokes it in each particular case, as far as this is possible.

But there remains a class of cases of great interest to which the name "paroxysmal hæmoglobinuria" has been given. The general opinion is that in these the hæmoglobinuria is a manifestation of hæmoglobinæmia, certainly in a great majority of cases, though Hayem[3] and Robin[4] maintain that the cythæmolysis is not systemic in these cases, but occurs only in the kidneys. If this view is correct, or in so far as it is correct, the consideration of the paroxysmal form

[1] *Boston Medical and Surgical Journal*, xcii. p. 277.
[2] *Deutsche med. Wochens.*, 1879.
[3] *La Semaine méd.*, 1889, Feb. 24. [4] Ibid., May 19, 1889.

comes under the head of diseases of the kidney rather than of the blood. It seems probable that both sides are right, some cases being systemic, some renal.

The chronic infectious diseases, syphilis and malaria, seem to underlie a certain proportion of the paroxysmal cases, and evidence as to the existence of these affections should always be sought for as a guide to treatment. But in many cases no definite constitutional taint can be made out, the two chief antecedents being exposure to cold and *walking* exercise. Striking cases are reported in which all other forms of exercise were perfectly well tolerated; but walking, not otherwise shown to be excessive, was followed by hæmoglobinuria, with or without pain in the back. It would seem that there must be some relationship between hæmoglobinuria and Raynaud's disease. Raynaud himself does not speak of having seen the association, but others have, and in a number of cases altogether too large to be attributable to coincidence alone. And yet there are striking points of difference; for instance, hæmoglobinuria is comparatively rare in females, while women seem much more liable to Raynaud's disease.

The treatment of paroxysmal hæmoglobinuria falls naturally into two divisions—that of the attacks and that of the prevention of their recurrence. Fortunately, the malady is very rarely fatal. During an attack warmth is the prime essential, and if there is marked general disturbance with fever, the patient is not unwilling to seek it in bed with hot bottles. If pain in the back is prominent, a poultice, to which mustard may be added with advantage, dry cups, or even an anodyne, are indicated. The late Dr. Druitt of London found hyoscyamus efficacious against this symptom in his own case. Even in cases without notable constitutional disturbance it is wise to insist on bed as soon as an attack appears or threatens.

The prevention of recurrences is to be attempted by great care in avoiding exposure to cold, especially during the early hours of the day, when experience shows that the attacks are most liable to come on. A hot drink should be taken before rising, and frequent meals should be taken in order to guard against exhaustion from lack of food. These precautions are the more necessary if arduous or unaccustomed work is to be undertaken during the day. It may be necessary to remain in the house throughout or during much of the winter, if refuge cannot be taken in a warm climate. Dr. Druitt found much benefit from wintering in Madras. The clothing should be chosen with special reference to warding off chill. Barlow and Ralfe endeavor to accustom their hæmoglobinuric patients to water gradually lowered in temperature, apparently without very gratifying results. It seems to be safer to abstain from alcoholic drinks and articles containing oxalic acid, and to be cautious in the use of asparagus, tea, coffee, and spices.

In short, a sufferer should give intelligent study to his own case, that he may ascertain and avoid as far as he can those exciting causes which operate on him. He may then hold his disease largely in abeyance if he cannot master it entirely. Quinine in large doses seems to be the best single drug, and should be tried faithfully even in cases without malarial history or exposure. If it fails, arsenic or Warburg's tincture may be used. Pampoukis and Chomatianos[1] of Athens cite a number of cases in which hæmoglobinuria was caused by quinine, especially the sulphate, in doses of eight grains or upward. Other salts of quinine and derivatives of cinchona-bark also produced the symptom of pain in the back in these cases, though larger doses were required. But cinchonine in doses of 30 grains, and quinquinia in large doses, proved innocent. These observers make a sharp distinction between these cases and those of malarial hæmoglobinuria, in which the symptom yields to quinine, and recommend the use of cinchonine or antipyrine in their treatment. Any evidence of syphilis calls loudly for specific treatment. If there is any resultant anæmia, iron should certainly be given. Astringents do not hold out much hope of usefulness, the essence of the trouble lying in destructive action on the red blood-corpuscles by some cause still unknown to us, but promoted more by exposure to cold than by any other one thing.

Addison's Disease.

If the diagnosis is correct, the most that can be expected from treatment is possibly palliation and the prolongation of an unenviable existance as comfortably as possible. This means rest, alimentation, fresh air, and a purely symptomatic medication. The liability to suddenly fatal syncope is to be borne in mind, and alcoholic stimulants are to be given freely during the attacks of great weakness which are not uncommon.

Hæmophilia.

The well-known hereditary character of this highly interesting constitutional affection suggests at once abstention from marriage by those subject to it, particularly by females, who are notoriously less likely to manifest the vice, though they are far more likely to transmit it to their descendants, than are males. Celibacy is probably not attainable by legislative enactment, and we must rely on voluntary action initiated and supported by medical authority. "At Tenna in the Grisons," we find in Fagge's *Practice*, "there were until lately two families, not known to be related to one another, in which the disease had been known to exist for a century. In 1855, the females of those families determined to renounce marriage, and in 1879 Immermann was able to state, on the authority of Dr. Hörsli of Tusis, that there was no

[1] *Progrès médicale*, July 7, 1889.

longer a well-marked example of hæmophilia in the village." So much for prophylaxis in the broad sense.

Jenner thinks that hæmophilia involves a tendency to plethora of the smaller vessels, and therefore recommends a light diet with but little red meat, and gentle purgation at stated intervals of a week or so. Legg thinks that after taking iron bleeding is less likely to occur, and to be less profuse if it does set in. A warm, dry climate is said to be of service. Those who are known to be "bleeders" should so govern their lives and select their occupation as to involve the least possible risk of blows and injuries. No surgical operation should be undertaken on them, not even the extraction of a tooth, unless it is absolutely indispensable; and then every conceivable precaution against hæmorrhage is to be taken until the healing process is quite complete, inasmuch as the recent thin cicatrix may reopen. Subcutaneous and deep extravasations, whether the result of injury or spontaneous, it is wise to let alone: sometimes they suppurate, but usually undergo absorption.

If bleeding has started, the usual measures for its arrest should be promptly instituted, carried out to the full, and continued longer than in ordinary persons. At the same time ergot, gallic acid, and the more astringent iron preparations are to be given internally in large doses, while mild purgation may be brought about if there is no intestinal blood-loss. The sulphate of sodium is specially recommended for the latter purpose. Hæmorrhage into joints is to be treated in the same way as if it occurred under other conditions; and it is to be borne in mind that synovitis may be closely simulated by articular extravasation, which is not necessarily preceded by trauma. The anæmia and debility following profuse bleeding are to be managed on general principles.

DISEASES OF THE LIVER, GALL-BLADDER, HEPATIC DUCTS, AND SPLEEN.

By J. H. MUSSER, M. D.

DISEASES OF THE LIVER.

The liver is the largest glandular organ in the body, and is naturally supposed to play an important part in the phenomena of the living organism. Just what this part is, has been a subject of much speculation and experiment. Until recent years its one undoubted function was believed to be the secretion of bile. Later, we learned that within the liver starch was converted into sugar, and the function of glycogenesis was added. Undoubtedly, this organ is one for sanguinification, while certainly it is the seat of destruction of the red-blood corpuscles. In the liver we have long known that, as in muscle and other structures, a metabolism of albuminoid substance takes place, and urea and probably uric acid are formed. In fact, at one time it was thought that all urea and uric acid was created in the liver. Finally, a very important office has been given to the liver; that is, the function of destroying or creating a barrier to poisons that enter the portal circulation through the gastro-intestinal tract and vainly attempt to pass into the general circulation. The secretion of bile, the formation of glycogen, the formation of urea, the formation of white corpuscles, and the destruction and excretion of poisons absorbed from the intestines are, then, physiological offices of the liver.

On *a priori* grounds we can surmise such changes in the working of the liver as would cause a state of discomfort, local or general, which we would call disease, and because the functions are altered we would call it a functional disease. It is remarkable how little we know about the functional diseases of glands: consider, for instance, how little is known of the functional diseases of the salivary glands. And likewise with the liver, and particularly of its excretory function. Indeed, in the pathology of glands we are almost forced to conclude that which is always true, but not obvious, though conceivable—*i. e.* that only altered function and altered structure go hand in hand. Even after generations of wise talk we grope about. "Biliousness"

is often spoken of, "sluggish liver" or "torpidity of the liver" written about, "excess of bile" or "diminished secretion of bile" talked of. When we think of the functions of the intestinal tract, the part the bile plays in it, and how the bile is constantly reabsorbed by the portal vein and carried back to the liver, only to be discharged again in a never-ending round, we can readily appreciate how impossible it is to give a physiological classification of functional disorders of the excretory apparatus of the liver which would tally well with clinical facts.

From the works of Strümpell, Fagge, Pye-Smith, Charcot, and Jaccoud, representing the modern state of medicine in three countries, we can form an idea of the difficulties. Strümpell does not write a word of such disorders. Pye-Smith places all clinical phenomena probably due to functional disorder of the liver, including lithæmia, under bilious dyspepsia. Charcot follows the classification of Murchison, while Jaccoud in his work on *Internal Pathology* does not make reference to any functional disease.

The late Dr. Murchison wrote extensively on functional disorders of the liver, and concluded that other offices of the liver are of much higher importance than the secretion or excretion of bile, while disturbances of that function are of minimum importance, if recognizable at all.

Moreover, when it is remembered how intimately associated, physiologically, are the functions of the stomach, duodenum, pancreas, and liver, it can readily be seen how difficult it is to separate clinically functional disturbances of these organs, particularly as the symptoms are usually very similar.

It is worth while remarking that a "bilious attack," in the parlance of the past, is now considered to be due to an acute dyspepsia or acute gastric catarrh, and that "biliousness," characterized by furred tongue, bitter taste in the mouth, slow digestion, flatulency, and sluggish bowels with pasty stools, is due to chronic gastric catarrh, to both of which a slight congestion of the liver may be added. When the latter is present the conjunctivæ are muddy, the complexion is sallow, and the urine loaded with urates, while, in addition to the above symptoms, pain in the right hypochondrium or right shoulder corroborates the idea of hepatic derangement. Disorders of the other functions have expression in pronounced derangements which are written over the whole body, as in diabetes and lithiasis or rheumatism and gout.

Of disturbance of the function of the liver last mentioned, but little can be said. Is it possible that in certain types of individuals this function may be in abeyance, and thus so-called "biliousness" arise? Are the persons who are susceptible to certain foods made so because this function is not active? Many individuals cannot drink milk or eat eggs or take certain fish. Perhaps some such poison as a peptone

which should have been destroyed enters the circulation in the liver, and it may be that poisons for this reason act more violently at one time than at another.

Notwithstanding a warranted scepticism regarding functional disorder of the bile-secretion, the state just spoken of, "Biliousness," will be treated of in this paper. Disturbances of the other functions, glycogenesis and urea-formation, will be treated of in the proper sections on Diabetes and Lithæmia.

In common with glands in general, the liver is made up of its special cells and a vascular network woven together by connective tissue, and of channels or ducts to discharge the products of excretion. The large size of the glands increases in importance the size and function of the ducts, so that morbid changes in them are a frequent and serious element in the pathology of the organ. Morbid processes, therefore, may be limited to the cells, to the vessels, to the connective tissue, or to the tubes themselves. Structural alterations of the gland do not differ from like alterations in other organs, and hence, singly or combined, morbid processes of degeneration, of congestion, and of inflammation may occur. By accident of situation the liver is covered with peritoneum. This is not, strictly speaking, a part of the organ, and hence diseases of the membrane are properly included among peritoneal affections.

The hepatic cells may be the seat of cloudy swelling or parenchymatous degeneration or fatty degeneration, the connective tissue the seat of inflammation, and the vessels the seat of congestion and amyloid degeneration. The processes in the respective parts may be either acute or chronic. In addition, the vessels may be the seat of embolic or thrombotic processes, simple or infectious, followed by the train of morbid changes wont to arise under such circumstances; hence abscesses and infarctions occur. Intimately connected as all are, morbid processes in either one of the structural components soon invade or deleteriously involve the other. Sharp lines of demarcation of processes cannot be drawn, and congestions, degenerations, and inflammations exist together frequently. Moreover, the organ is a nucleus for parasitic diseases, chief of which is the echinococcus which leads to the formation of hydatid cysts.

The channels of excretion, as before intimated, are so large that morbid processes arise in them independently of the secretory substance proper. Made up of epithelial structure and of connective tissue, nourished by a generous blood-supply, degenerations, congestions, and inflammations would naturally be expected, and indeed do arise. Moreover, the epithelial structure of the tubules, subjected frequently to irritation, invites the development of inflammation characteristic of mucous surfaces, and of new formations, as cancer, just as the lym-

phatics and blood-vessels gape wide for stray cells from distant morbid areas of sarcomatous change. In a gross sense, when compared to the delicate processes first mentioned, such further change may arise as would lead to narrowing or complete closure of the channels, for the outflow of the bile is obstructed in its course, causing many ulterior results. The free outflow of bile may be interfered with, and it then becomes more concentrated, and finally gall-stones are formed.

From the foregoing summary we can readily appreciate the morbid states of the liver that require the attention of the therapeutist. In this essay the management of the following diseases, in the order indicated, will be discussed:

FUNCTIONAL DISORDERS.
"*Biliousness.*"

ORGANIC DISEASES.

OF THE CELLS.
The Degenerations.
Fatty.

OF THE VESSELS.
The Congestions.
Active.
Passive, including { nutmeg liver and red atrophy.
Emboli and thrombi, as in (1) multiple abscess;
(2) thrombosis of portal vein, with occlusion or inflammation.
Amyloid disease.

OF THE CONNECTIVE TISSUE.
The Inflammations.
Acute diffused hepatitis (acute yellow atrophy).
Acute localized hepatitis (abscess), { Tropical, Traumatic.
Chronic hepatitis.
(Cirrhosis, { Alcoholic, Hypertrophic, Secondary.
Leukæmia.
Syphilitic hepatitis.)
Tuberculosis.

HYDATID CYST OF THE LIVER.

DISEASES OF THE BILIARY DUCTS.

Inflammations.

Acute catarrhal inflammation.
Acute purulent inflammation.
Chronic catarrhal inflammation.
Adhesive inflammation of the duct.

Occlusion of the ducts.
Carcinoma.
Gall-stones and their consequences.

DISEASES OF THE GALL-BLADDER.

Inflammations.

Acute.
Chronic, with enlargement.

It is not idle for the therapeutist to contemplate the functional derangements or organic processes that are possible in this or any other organ; for, on the one hand, he at once learns how limited are the resources derived from the Pharmacopœia for the cure of liver diseases, while upon the other he knows, from such knowledge, how the application of such remedial powers as removal of the cause of a given disease and attention to hygiene, including regulation of diet, habits, exercise, bathing, clothing, physical and mental labor, are powerful and essential factors for good, while the effects of climatic and balneological therapeutics are readily appreciated. This is particularly true with liver diseases, for in these the causes are very frequently preventable or controllable. Furthermore, hepatic disease, once developed, is often controlled by properly regulating the work of the economy and its varied organs to suit the changed structures. The changed liver must fit into a new environment, or rather an environment within the body must be created for the diseased organ. Harmony of function must be established throughout the system.

This can be done by regulating the physiological action of the liver. We must not be satisfied with securing such small gain, however. The entire organism must be treated—treated, not by drugs, but by means more powerful and more permanent. The plane of health must be raised by measures spoken of in the preceding paragraph. As a step in the right direction the various functions of the hepatic gland must be stimulated or repressed by proper diet. Usually repression or restriction of functional acts is necessary; the organ must be relieved of work. Hence certain classes of foods that are transformed or broken up in the liver, or that are acted upon by the bile, are to be excluded. The vascularity of the organ and the movements of the fluid contents of the tubes must be properly regulated. The use of proper food, exercise, clothing, and bathing attains this end. A high degree of general

health must be secured; and the methods previously indicated in Volume I. of this SYSTEM to attain this end require application in all forms of hepatic disease. They will be discussed, therefore, in a general manner before individual diseases are treated.

In the same general manner a few paragraphs will be devoted to the action of drugs in liver affections and the mode of administration of these remedies.

Symptoms common to many varieties of hepatic disease will be discussed, and the treatment of them as far as they do not appertain to special diseases will be detailed. Thus jaundice is common to many diseases. It is a symptom with symptoms. Space will be spared by devoting some remarks to it, as well as other symptoms, in a separate section. In like manner ascites and gastro-intestinal congestions will be treated.

Diet in Liver Diseases.—Much can be accomplished by carefully regulating the diet in both functional and organic diseases of the liver. In the first place, the amount of such foods as are utilized by the liver in the performance of its functions must be controlled, and for this reason sugars, starches, and fats are prohibited or curtailed in amount. Second, the use of preparations of food which are not stimulating must be enjoined. Richly-prepared foods—curries, pastries, soups highly seasoned—spices, and stimulating dishes generally must be excluded. Foods prepared in fatty substances are not admissible, and likewise all dishes made with sugar must be excluded. Usually, a certain amount of starchy food may be allowed if it is properly prepared; thus pastries and bread freshly made are not to be used; but, unless a very rigid diet is necessary, bread stale or toasted may be allowed in smaller quantities than usual. Saccharine articles of diet must be particularly excluded, not only because the liver is relieved of work, but especially because of fermentation due to intestinal dyspepsia, which almost certainly accompanies hepatic disorders.

In the later stages of organic hepatic disease and in advanced congestion red meat should not be allowed, but white meats and game are admissible. Fish and oysters can always be used, except salmon, eel, and other fish of an oily nature. Eggs and milk, and preparations of each, are proper if they agree with the patient, but some persons, on account of idiosyncrasy, find it difficult to take them. Often under these circumstances milk, which otherwise causes so-called "biliousness," may be used if it is sterilized or if it has previously been peptonized. It also may be more suitable to a patient if administered hot—not boiled, but scalded, and with a little salt added. Alkalies added to the milk render it less disagreeable at times. Lime-water, or bicarbonate of sodium, or a carbonated alkaline water, such as Vichy, removes the unpleasant taste that many patients complain of and renders the milk

more readily assimilated. In place of milk, whey or buttermilk may be used; the slight acidity of the latter is very agreeable to some patients, and both appear to be of advantage if a diuretic effect is required. Nourishment may be sustained by koumyss and other artificially prepared forms of milk. To bridge over a critical period malted milk may be employed, or condensed milk will stand in good service. The latter may be flavored with weak infusions of tea or cocoa to make it more palatable.

While sugars and starches are to be excluded in hepatic disorders, and beans, potatoes, peas, and other legumes forbidden, for a time at least; fresh vegetables generally may be used. Lettuce, if not dressed in oil, celery, spinach, tomato, squash, pumpkin, oyster-plant, and the like, are vegetables from which a number of palatable and serviceable dishes may be made.

In the selection of food the dictum of the late Professor Flint must be observed. The appetite and common sense are to be consulted. It is never to be forgotten that most serious results may ensue from continuing a strictly exclusive diet too long. The effect of a rigid diet on the stomach and the general system must be noted carefully. In every case a return to a general diet is necessary. Some of the most severe cases of functional gastric disorder arise from a too restricted dietary.

Ale, porter, and beer should not be used. All sweet wines must be interdicted. Acid wines alone are advisable if a stimulant is actually required, and some of the more acid clarets or the Rhine wines may be used. Champagne, madeira, port, and sherry must be prohibited. Coffee should almost always be forbidden; it may be used sparingly, provided the state of the gastric functions do not contraindicate it. Preparations of cocoa, if free from the oily substance that so usually accompanies them, may be given.

While a selection of proper diet is necessary, it is also well to insist upon proper methods of eating. Food should not be taken when the body is fatigued. If at the usual time for a meal the patient feels exhausted, fifteen minutes' or a half hour's rest in the recumbent posture should be insisted upon before partaking of food. At the time of resting a plate of light soup may be given. The acts of mastication should be performed properly, and this must be particularly insisted upon if some starchy food is allowed. If the patient cannot masticate properly on account of bad teeth, these should be attended to at once. Food should be eaten slowly and mixed with only a moderate amount of fluids. In certain forms of liver disease, to be spoken of later, fluids must be excluded almost entirely. It is often necessary to administer the food frequently, and indeed in congestion of the liver and extensive organic disease it is much better to give food four or five times, rather than three times, a day.

Exercise.—An out-door life and exercise within reasonable limits are of the greatest importance in the management of liver disease. Such exercise as will contribute to the general health is advised, as well as exercise which stimulates the abdominal circulation. It is particularly necessary to those who are leading a sedentary life or occupation. The exercise should not be violent, and it should develop the muscles of respiration as well as the abdominal muscles. This is quite necessary, for when the respiratory acts are complete circulation is more active in the liver. Of forms of exercise for increasing the abdominal circulation horseback riding and rowing are the best. Walking is not so good. Half an hour of either of the former is of more service than two hours of the latter. If exercise cannot be secured in the open air, gymnastics may be resorted to, and special training of the muscles just indicated is necessary. Massage must be prescribed for those who are unable to go about or take exercise as they should. The object of massage is more particularly to develop the muscles, to increase the functions of the skin, and, in certain forms of disease, notably functional disorders with constipation, the congestions of sedentary life, and the fat liver of the obese, to stimulate the circulation in the abdomen.

Climate.—The climate selected for invalids suffering from liver disease should be stimulating and tonic in character. The mountains of Switzerland are usually selected by the physicians of Carlsbad and other springs in Germany for patients to resort to in order to complete a cure. Residence by the sea is of benefit to many.

In the United States country life generally answers, and Northern New England and Northern New York furnish an abundance of places where the summers can be spent profitably. The robust who suffer from functional liver disorder do well camping out. A summer on the Plains, in the woods of the Adirondacks, or in Northern Canada changes almost entirely the physical condition and mental state of a man who by sedentary life and prolonged application has become a physical wreck. The winter months could be profitably spent in the southern and south-western parts of the United States. It is essential to remember that an out-door life with exercise is necessary for success in the treatment of properly selected cases of liver disease.

Of course diseases of the liver which arise on account of climatic influences require change to other countries. The Englishman in India must return home, and patients in insalubrious climates must promptly leave if hepatic disease arise. Non-malarious districts must be selected by persons in whom liver disease has originated on account of malaria.

Clothing.—The clothing should always be warm and its weight graduated to the temperature; woollens should be used and the extremi-

ties be well protected. Every one who by occupation or residence is liable to congestion of the liver should have the hepatic region and abdomen protected by wearing a heavy flannel bandage. Heavy boots should always be worn. The habit of wearing slippers should be corrected.

Bathing.—General baths, cold sponge-baths, or douches should be insisted upon in order to keep up the action of the skin, as well as for their tonic effect. The cold shower-bath, followed by a brisk rubbing, or a plunge in a tub of cold water, with rubbing afterward, providing reaction always takes place, will ensure healthy action of the skin and give general tone to the patient. Such baths are particularly necessary in patients of sedentary occupation, who lack opportunities for acquiring tone and keeping up that state of the system which attends high health. Sea-bathing with the usual precautions will be of great value to broken-down subjects.

Medicated baths are used for chronic diseases of the liver. The acid bath is the one most frequently employed. Eight ounces of nitro-hydrochloric acid are mixed with each gallon of water at 98° F. The same solution may be applied as a compress. A flannel roller about a foot wide and long enough to go twice around the body is saturated in the acidulated water, wrung out thoroughly, and wrapped around the region of the liver. It should be covered with a piece of oiled silk slightly broader than the flannel, and may be worn several days or until decided irritation of the skin is produced. It should be changed every night. If an acid bath is given, the vessel must be of wood, earthenware, or porcelain.

Hot baths are prescribed at many of the springs where the waters are taken for liver disease At home the general hot bath relieves the pain of hepatic colic and aids the passage of the gall-stone. In congestion of the liver the hot bath, with good rubbing afterward, is of great service. The enlarged, congested liver after catarrhal jaundice is reduced by baths. The sitz-bath is of value for the relief of abdominal plethora. At Carlsbad peat- or mud-baths are used for the same purpose. After each hot bath the patient should rest for two hours. The bath should not be taken until one and a half hours after a full meal, and not after violent exercise or great mental excitement: the morning hours are the best. The bath may be taken on retiring, although additional rest is not secured. The water should usually be at a temperature of 90° to 95° F., but it may be raised to 100°.

Hot baths are weakening, and should be taken only two or three times a week. If congestion of the brain, as evidenced by giddiness, noise in the ears, or pain in the head, occurs, the patient should not take them.

The baths may be medicated, although the value of the medication

is doubtful. Carlsbad Sprudel salt added to the water may be of service, or bicarbonate of sodium may be used. For stimulating purposes common or rock salt may be added to the water.

Vapor-baths and douches are often very useful. Douches or "needle"-baths, or alternating hot and cold douches played on the liver, are local stimulants of value. The Turkish bath may be used by the robust. In jaundice it aids in removing the discoloration of the skin.

Residence.—Persons in whom there is a tendency to, or who are the victims of, diseases of the liver should reside in a neighborhood that is dry. The house, of course, should be supplied with all sanitary comforts, and hence the drainage should be of the best. For patients with chronic liver disease a house that is exposed to the sun during the most of the day and sheltered from high winds is of course the best, and to the house a conservatory or sun-parlor in which the patient can take exercise ought to be attached.

Occupation.—Of course a sedentary occupation for those who are liable to attacks of biliousness, so called, or who have other manifestations of disordered hepatic functions, should not be permitted. If possible, an out-door occupation which admits of change of posture during business should be selected. Often one which involves horseback riding or methods of locomotion which compel exercise of most of the muscles of the body should be advised. The bicycle has been of service in restoring to health many cases of congestion of the liver or of fatty liver due to over-eating and sedentary occupation.

Occupations which compel the patient to be constantly nibbling at rich foods and condiments, or sipping at alcoholic drinks, are to be condemned. Some individuals who are exposed to sudden and marked changes of temperature or to repeated wetting of the skin are thereby rendered more liable to hepatic disorders. Laborers in rolling-mills, furnaces, or in damp, wet places belong to this class.

The foregoing are simply hints at occupations that are disadvantageous. Often in individual cases, if sought for, the causal relation of occupation to disease may be disclosed.

Habits.—Luxurious habits must be dispensed with. In the prevention and treatment of hepatic disease the establishment of regular, systematic habits of life is of the greatest importance. Proper and fixed hours for retiring and rising, for meals, for work, for rest, for bathing and exercise, must be secured. If coupled with proper food, nothing is more certain to produce good results in medicine than a régime of this character.

Action of Drugs on the Liver, and the Method of their Administration.

Drugs which act on the liver and increase the flow of bile are known as hepatic stimulants; if they diminish the flow of bile, they are known as hepatic depressants. Although the secretion of the bile is increased by hepatic stimulants, it is not carried out of the system. Drugs which act upon the intestine, and in that manner remove bile from the body, are known as cholagogues. Therefore, in order to carry off bile from the body very thoroughly, it is necessary to combine an hepatic stimulant with a cholagogue. Any active purgative is an hepatic depressant. It carries away bile that would be re-excreted and food that would help to make bile.

Hepatic Stimulants.—Food is an hepatic stimulant. After a meal the flow of bile is rapidly increased. Some classes of food appear to cause this increase more freely than others. The succulent vegetables, as spinach, tomatoes, the cresses, and the like, are thought to have such an effect, and should be included, unless otherwise objectionable, in any regimen which attempts to increase biliary secretion.

Water is also an hepatic stimulant. Its virtue is increased if taken hot, and also if taken when the stomach is empty. The hot water is quickly absorbed. It enters the portal circulation and is carried directly to the liver. The pressure in the blood-vessels is increased by rapid absorption of the water, and the pressure on the bile-ducts is also increased; hence bile which is present is carried out of the ducts more rapidly, and practically the liver is washed out. If to the hot water some saline is added which by experiment we know increases the flow of bile, the effects of the water are much increased. The salts of Carlsbad (which contain a large amount of phosphate of sodium), the phosphate of sodium alone, or any of the alkalies included in the list of drugs when administered for the purpose of relieving congestion, and overcoming stagnation of bile or cholelithiasis, act very well. It is by virtue of this effect that springs the waters of which are alkaline and charged with carbonic acid are in vogue in cases of liver disease. No one can doubt the effect of taking the waters at one of the popular springs, but this effect is much increased by the strict regimen that the patient follows while pursuing the treatment. The springs which are best suited for cases of liver disease are those of Carlsbad, Marienbad, Kissingen in Germany, and Vichy and Contrexeville in France, and in this country Saratoga and Bedford.

Just here it may be worth while to speak of the class of diseases benefited at these resorts, and give some indication which will be of

value to the clinician who wishes to send patients to them. The cases that are most benefited by springs, such as those of Carlsbad, are those suffering from chronic congestion of the liver, fatty liver, the first stage of cirrhosis of the liver, and cholelithiasis or gall-stones. Amyloid disease of the liver, if associated with much congestion of the abdominal viscera, may be improved by the use of such waters. The use of the waters of these springs is contraindicated in any of these diseases just mentioned if they are accompanied by high fever. If there is also the simultaneous occurrence of organic disease of the brain or spinal cord, tuberculosis, valvular disease of the heart, or Bright's disease of the kidney, the waters should not be taken. Cancer of the liver and malignant tumors generally should not be treated in this manner.

It must be remembered that patients who go to springs for relief must not expect to leave the "cure" and at once return to their avocations in good health. This is particularly true when the waters of hot springs, which appear to be the best, are taken. The action of these waters is rather weakening. It is by depletion that the patient is relieved. It is necessary, therefore, to complete a cure by residence at other springs which are more tonic or by rest and quiet in the mountains. Patients at Carlsbad usually go to Switzerland, or they carry out a subsequent course of treatment in a milder degree at springs which do not act so vigorously. In this country if a patient has been benefited by the waters of Saratoga or Bedford or the Hot Springs of Arkansas, it is well that he should go to the seashore for rest.

It has been stated that the good effects of the waters are increased by the strictly hygienic life which the patients lead at certain springs. It is unfortunate that in this country the springs which are of value for the relief of liver diseases as well as other complaints are used so much by the votaries of fashion. The many distractions that exist at these places, and the constant catering of the citizens and hotel proprietors to fashionable people, render it very difficult for an invalid to carry out a systematic plan of treatment. It is to be hoped that in the future the creation of a proper sentiment will aid in changing these resorts into their proper channels. This is more possible each year, for with the increase of wealth in the country more patients will resort to the springs who can make it an object for the owners to cater to them and their needs. The broadening of therapeutic methods by the physicians of the day will also render such plans of treatment more popular.

Both experimental evidence and clinical experience show that the bile-secretion is increased when milk, hot water, or other fluid is taken slowly. Brunton and others have shown that the act of sipping is a

stimulus to those centres which control arterial pressure and the heart itself. Beyond doubt, sipping water with exercise, as carried out at Carlsbad, increases the secretion of bile. It increases the blood-pressure within the liver, and hence the bile-pressure. Exercise always helps the action of medicines upon the liver. Both the above adjuncts are particularly useful in connection with a carefully-planned regimen, as conducted at most springs.

It has been thought by some observers that medicaments for the liver had better be taken in large quantities of water, fasting, in order that the liver may be promptly acted upon. In this manner Guitéras and Bruen used iodide of potassium in chronic catarrhal jaundice in small doses in a glass of hot water before breakfast. Other drugs may be employed in a similar manner.

In the main, our empirical knowledge, derived from clinical experience, as to the drugs which stimulate the liver is correct, as recent experiments by Rutherford and Vignal, and by Röhrig, have corroborated this knowledge. In one or two instances the clinician was notably wrong. It was formerly thought that the mild chloride of mercury was an hepatic stimulant of the first rank. Its administration had always been followed by the discharge of so-called bile and by relief from the bilious symptoms. It was proven by the above-named experimenters that such is not the case, and that the supposed action of calomel on the liver is due to the transformation of the drug into the bichloride of mercury, the effect produced being due to the action of the latter and the purgative effect of the former. In this way calomel is an hepatic stimulant and cholagogue, and without doubt is more efficient in small and frequently repeated doses. In certain states to which the term "biliousness" is applied it is the best drug we have. It is also an intestinal antiseptic.

The following classification is that of Rutherford, and by it the practitioner can at a glance see the armamentarium with which he can attack hepatic disorders:

Powerful hepatic stimulants:

Podophyllin,
Aloes in large doses,
Colchicum in very large doses,
Euonymin,
Iridin,
Sanguinarin,
Ipecacuanha,
Colocynth in large doses,
Dilute nitro-hydrochloric acid,
Sodium phosphate,
Potassium sulphate,
Phytolaccin,
Sodium benzoate,
Ammonium benzoate (less than the latter),
Sodium salicylate,
Ammonium phosphate,
Mercuric chloride.

Moderately powerful stimulants:

Leptandra,
Jalap,
Sodium sulphate,
Baptisin,
Hydrastin,
Juglandin,
Benzoic acid.

Drugs that have feeble or no effect:

Croton oil,
Rhubarb (certain, but feeble),
Magnesium sulphate,
Castor oil,
Gamboge,
Ammonium chloride,
Scammony,
Taraxacum,
Rochelle salt,
Sodium bicarbonate,
Potassium iodide,
Calabar bean (autogenized by atropine, not powerfully),
Menispermin,
Tannic acid,
Acetate of lead (lessens the secretion of bile),
Jaborandi,
Sulphate of manganese,
Morphine,
Hyoscyamus,
Diluted alcohol,
Calomel.

If it is desirable to carry bile out of the system as well as increase the secretion, drugs which have both effects in a moderate degree may be combined. It is always important not to secure a severe purgative effect, such as that induced by magnesium salts or castor oil. If great purgation takes place, the secretion of bile is diminished. Hence, clinically, aloes is not a good hepatic stimulant; theoretically, it is one of the best.

If it be remembered that certain drugs are not well borne by persons of a so-called bilious temperament, the therapeutist will often save much trouble, and even gain a reputation in a laudable way. The drugs which cause constipation by arresting secretion are most harmful. Preparations of iron are usually not well assimilated and create disturbances. Opium and its alkaloids also cause disagreeable symptoms, and cannot be taken even in small amounts by some.

Symptoms of Hepatic Disease.

The treatment of symptoms common to many disorders of the liver will now be discussed. The first symptom mentioned, ascites, occurs in all forms of chronic hepatitis, in cancer of the liver, and in inflammation and thrombosis of the portal vein.

Ascites.—The measures employed to remove the collection of fluid in the peritoneal cavity are of a depletory nature. Diaphoretics, diuretics, and cathartics are used in turn singly or combined. Surgical means

must be resorted to at times, and indeed it is a grave question whether it should not be resorted to much earlier than is customary, particularly in cases of cirrhosis.

Moderate diaphoresis at least should always be secured by suitable clothing, frictions, and the maintenance of a proper temperature of the room. It is scarcely advisable, unless there is general anasarca with associated renal disease, to use diaphoretics that produce profuse flow of perspiration—such as the hot wet pack, Simpson bath, and jaborandi and its alkaloid. Active diaphoresis by this means may be used at rare times.

Diuretics are of more service, and diuretics which act by means of their tonic effects upon the general circulation are of the greatest benefit. Stimulating diuretics, so called, are also of value. To the former class belong drugs like digitalis, caffeine, cocaine, and strophanthus. When the heart is weak or dilated, some one of these drugs is indicated without doubt, but they may be likewise used when the physical signs of cardiac dilatation are not present. The best of these is digitalis, of which the tincture or infusion may be used: large doses should be given, and hence 10 or 15 drops of the former and 1 or 2 table-spoonfuls of the latter every three hours are needed. Tincture of strophanthus is often of great value, but its effect is soon lost unless the dose is frequently increased. If 5 drops are administered at first, the dose should be increased every three or four days to 10, 15, or 20 drops. Caffeine is also a good diuretic, and acts well in cases of ascites. It has the disadvantage of causing wakefulness, which is very persistent in some individuals. From 2 to 5 grains of the drug given every three or four hours promote abundant secretion. Hydrochlorate of cocaine increases the action of the kidneys when the effects of other drugs appear to be lost. One-fourth of a grain administered every three hours is sufficient to cause an increase in the flow of urine. It may be given with other diuretics, as will be indicated in another paragraph.

The diuretics which belong to the stimulating class stand next in order, the best of them being copaiba. This drug should be administered in capsules in doses of 5 to 10 minims three or four times daily. It almost always produces an increase in the flow of urine. Scoparius is used a great deal, and is often of much value. The infusion, taken *ad libitum*, is a domestic remedy to increase the action of the kidneys. An alkaline diuretic is often combined with it, and a wine-glassful of an infusion, freshly made each day, may be given every three hours with 10 to 20 grains of acetate of potassium or bicarbonate of potassium. Cream of tartar, administered in the form of cream-of-tartar lemonade, or the "imperial drink," is another diuretic which may be substituted for an infusion of scoparius when the latter becomes nau-

seous. It frequently does good service. The oil of juniper or the compound spirit will often avail. The tincture of apocynum canabinum was advised by older writers, and the writer has seen several instances of good effects of this drug. It acts chiefly as a diuretic, but often at the same time causes purgation—an effect generally desirable. From 10 to 20 drops of the tincture every two or three hours, well diluted, are used.

One of the best diuretics is calomel. It certainly increases the flow of urine very much, and in the course of treatment of ascites may be alternated with other diuretics. The usual mode of administration is to give it in $\frac{1}{2}$-grain doses every three hours. The writer has seen a patient not only very ascitic, but water-logged, relieved by the administration of this drug. It has the advantage that it can be given when the stomach refuses to accept other drugs. Calomel may be combined with other diuretics. When the tongue is furred and nausea is present with constipation, calomel combined with caffeine acts very well: the influence of the calomel on the gastro-intestinal tract is secured, and a diuretic effect is obtained from both drugs. Under these circumstances caffeine will be retained by the stomach when other diuretics will be vomited.

A very valuable diuretic is secured in the combination of calomel, squill, and digitalis: a pill containing 1 grain of digitalis, $\frac{1}{2}$ grain of squill, and $\frac{1}{8}$ grain of calomel, administered three times a day, very promptly produces an increase in the flow of urine, and is one of the best diuretics that can be employed.

Purgatives are essential. Either salines or the vegetable cathartics which produce watery evacuations are to be selected. Saline cathartics alone may be sufficient: 6 to 10 ounces of the effervescing citrate of magnesium, repeated two or three times in the morning, will produce free, watery evacuations, attended with diminution of the ascites. Rochelle salt, administered in the morning, is likewise of service, as is the sulphate of magnesium. Hunyadi water, Friederichshall water, the German bitter water, and the purgative waters of Saratoga, Bedford, and other springs in this country, are also useful.

Compound jalap powder is a serviceable purgative. Copious stools are produced without causing exhaustion of the patient. A drachm may be administered daily, and repeated if necessary once or twice in the twenty-four hours. It may be used thus for a week unless exhaustion becomes marked. It does not usually cause pain. Elaterium is another purgative which is of service. Clutterbuck's elaterium, $\frac{1}{4}$ or $\frac{1}{2}$ grain, will usually produce free catharsis. It should not be administered, however, continuously, but reserved for emergencies.

In addition to the class of drugs just mentioned, tonics are called for. The full effect of a diuretic is kept up by the use of strychnine, increasing its dose in accordance with the susceptibility of the patient.

Faradization of the abdominal walls has been recommended by some clinicians for the relief of ascites. Cases have been reported in which, following the use of this method, the dropsy gradually disappeared; the cases, however, are too few to give us much confidence in this form of treatment.

It must not be forgotten that rest, combined with a milk diet and diuretics, is of the greatest importance. The milk-cure and grape-cure must be utilized.

Tapping the abdomen is a certain way to remove an accumulation of fluid in the peritoneal cavity. The question does not arise in the mind of the therapeutist whether it is a measure which will succeed, but rather whether this operation should be done early or postponed until serious symptoms develop on account of the large accumulation of fluid. The fluid within the cavity interferes with the circulation and nutrition of organs, prevents free movement of fluid in the lymph-spaces by pressure, certainly interferes with the action of the kidneys, and for these reasons should be removed early. So many failures attend the use of drugs that the writer feels sure, particularly as paracentesis is fraught with so little danger, that this method of removing the fluid should be resorted to early—before changes due to pressure become permanent. If done early, the fluid is not likely to reaccumulate, and even if it should there is no reason why frequent aspiration should not be done. There are a number of cases on record which have been tapped many times with no bad results. The dangers thought to attend the performance of this operation are peritonitis and septicæmia from primary infection or after non-closure of the punctured wound. In the writer's experience they have been of little moment, and in no case have any deleterious results followed tapping. Sometimes after tapping the puncture does not close, and it is thought that the drainage that results is weakening and indirectly causes the death of the patient. This has not been the case in the large number of patients the writer has treated. When the wound did not close the constant dripping of the fluid seemed beneficial to the patient. Such benefit is seen in cases in which Nature performs the operation. In two instances the writer has observed rupture to take place at the umbilicus, followed by gradual draining of the cavity, with most beneficial results. It does not appear to exhaust the patient to tap frequently, although some assert that such is the case, and argue against early tapping on this account. If, however, the physician does not believe in early tapping for the treatment

of ascites, there are certain indications for the performance of aspiration later. When the fluid accumulates to such an extent as to interfere seriously with respiration and the action of the heart, and, probably, causes attacks of palpitation or of smothering, then the operation must be performed.

Dislocation of the heart, increased frequency of action of that organ, with shallow and hurried breathing, are serious effects of ascites. Even before more marked threatening symptoms occur, in the writer's opinion the abdomen should be tapped whenever it has become so large as to compel the patient to assume an upright position in bed. If the operation is delayed, death frequently takes place suddenly on account of interference with the heart's action, especially after exertion, even if symptoms pointing to this interference have not been present previously.

Paracentesis Abdominis.—The instruments required are simple. An ordinary trocar and canula may be employed. Southey's trocars, or the trocar and canula which Dr. Douglass Powell devised, are used if it is thought better to drain gradually. In order to remove the fluid without soiling the patient and bedding, a flexible rubber tube may be attached to the trocar to conduct the fluid to a vessel near the bed. The abdomen should be cleaned with an antiseptic solution in accordance with the rules for the performance of any abdominal operation. The bladder should be emptied before the operation and the patient given a stimulant. The point selected for inserting the trocar should be in the median line, about midway between the umbilicus and symphysis pubis, or about four inches above the latter point. Before the operation the abdomen should be enveloped in a broad bandage, the ends of which have been equally divided into a number of tails, and this bandage held in place by an assistant at the back of the patient. In order to induce gentle, equable pressure over the abdomen and support the abdominal walls, traction on the different portions of the bandage should be made as the fluid flows out; first the tails in the upper portion should be drawn upon, and as the abdomen decreases in size the middle and lower tails should be tightened. When the operation is completed they may be tied at the back or side. In order to prevent pain, the skin at the point determined for puncture should be anæsthetized. This may be done with salt and ice, holding them in contact with the skin until it is frozen. Rhigoline spray or other methods of anæsthetizing the skin may be used. During the flow of the fluid the patient often becomes faint, and stimulants should be administered at this time. Sometimes the fluid becomes bloody as it flows out. This should not necessarily cause alarm. If the trocar comes in contact with the intestine, it may cause a little bleeding, or adhesions may also be the cause of the flow of blood. Very frequently it occurs

at the latter part of the operation, and comes from the wound in the abdominal wall.

Should all the fluid be removed? Probably with the first aspiration, especially if the accumulation had been very great, the entire amount should not be removed at once, but more thorough aspiration done the next day. If, however, no uncomfortable symptoms arise and the fluid is small in amount, it may all be withdrawn with safety. This can be quite well accomplished by the pressure of the bandage on the abdominal walls, aided by pressure of the hands of the assistant in the flanks, and, if necessary, tilting the external end of the trocar upward in order to reach the fluid in the lowest portions. The patient may safely lean forward in order to favor the gravity of the fluid toward the trocar. After removing the trocar, which should be done rapidly, the point of puncture should be covered with borated cotton or an antiseptic dressing held in place by adhesive strips. Some authors advise closing the wound by a stitch if leakage continues after operation, but, as stated above, the writer does not fear any bad results from this leakage, and would let it alone.

It is not to be forgotten that freezing the skin in old people or debilitated subjects may cause serious sloughing, hence in such cases it should be avoided or else great care exercised.

Jaundice.—The method of treatment selected for the relief of this symptom will depend entirely upon the cause. Jaundice that arises from catarrhal inflammation of the bile-ducts requires treatment directed to the relief of the associated catarrh. In jaundice from obstruction by gall-stones efforts should be made to remove the stones and cure the state which leads to their formation. If the obstruction is irremovable by medical means, surgical interference will be necessary. Jaundice due to obstruction from causes outside of the duct, as well as from malignant diseases or organic diseases of the duct, such as stricture, adhesive inflammation, etc., is treated as a symptom only, the cause being generally not removable. Jaundice which occurs independently of mechanical obstruction of the ducts is likewise treated on general principles. The cause, if possible, is removed, and the deleterious effects of the presence of bile in the blood and tissues is counteracted by remedial measures. In this section jaundice will be discussed as a symptom only, bearing in mind the general principle of the removal of the cause if possible.

The most serious effects of jaundice are upon the blood and the nerve-structures. Such methods should be used as will keep up the integrity of the blood as much as possible. This can only be done by the food and stimulants which ensure the highest degree of nutrition possible. The character of the food selected must be in accordance with the principles of the dietetic management of liver disease.

Tonics and stimulants also are required. In addition to proper feeding, attempts must be made to eliminate the bile as rapidly as possible, and therefore one of the first principles of the treatment of jaundice is to attend to the secretions. The bile is discharged from the blood chiefly by the kidneys, and the functions of these organs should be kept active. This must be accomplished, first, by hygienic regulations that will ensure their action and prevent congestion or inflammations; secondly, by the use of food and fluids which tend to increase the flow of urine. Large amounts of water are of use, and milk and diluents may be given freely. The mild diuretics are admissible. Alkaline waters that are diuretic and the alkaline chalybeate waters are preferable. Citrate of potassium, bicarbonate of potassium, cream of tartar well diluted, and infusion of scoparius are the diuretics to be selected. The action of the heart must be watched closely, and digitalis given as a diuretic, and also with the view of keeping up the strength of the heart. Any tendency to diminution in the flow of urine should be met by cupping over the kidneys, by rest, and by diversion of the blood to the skin, with diaphoretics and warm applications; or a hot bath may be used. The constant irritating effect of the bile is liable to excite nephritis, and this must be carefully guarded against if possible.

Jaundice is always attended by mental sluggishness, drowsiness, or even stupor, increasing to coma. Just as the effects on the blood are to be averted by the elimination of bile, so when symptoms of stupor develop the organs which discharge bile should be stimulated. Increased action of the skin and the kidneys must be secured. Stimulants must be used in the more severe cases, and preparations of ammonia administered freely. Apart from stimulants there are no drugs which will relieve the symptoms of cholæmia—symptoms which are always very grave.

Itching.—The sleep of the patient is so much disturbed, and the nervous system so perturbed by the itching that frequently ensues in all forms of jaundice, that some means must be used to control it. In former times it was thought that the itching was an indication of the obstructive form of jaundice, but undoubtedly it is seen in all varieties, and grave obstructive jaundice may occur without itching. Warm baths, sponging the body with hot water, and stimulating frictions may suffice. Solutions of bichloride of mercury, 1 : 10,000, are often beneficial. Hot alkaline waters, as bicarbonate of sodium, $\frac{1}{2}$ ounce to the gallon, may be required; sponging with 10 to 20 drops of carbolic acid in a pint of water will also relieve the troublesome itching. Frequently remedies that induce a general action of the skin are of service. Hot drinks may allay the itching for a time, hot sage tea being used by a number of practical physicians with good results. Hot alkaline dia-

phoretics likewise will give some relief. Dr. Goodhart has recommended the use of pilocarpine and gives very strong testimony in its favor. The drug is administered hypodermically, and its administration is followed by relief after a few hours; $\frac{1}{12}$ grain is given in each dose. In the use of the bichloride of mercury care must be taken not to employ it too freely when the skin is broken by scratch-marks. Discoloration of the skin may be removed or its removal hastened by hot baths or hot alkaline baths, by the use of frictions, and by the application of stimulating liniments to the surface of the body.

The derangements of digestion that attend jaundice are to be relieved by a diet carefully selected and regularly administered. Articles that undergo fermentation are forbidden. When jaundice is present, there is usually deranged secretion of bile, and hence foods the digestion and assimilation of which depend upon this fluid in the intestinal canal must be excluded. It is sufficient to say that starches, fats, and sugars are to be left out of the dietary. Flatulency is usually a very marked symptom, on account of the fermentation due to the absence of bile. It may be relieved by drugs that prevent fermentation, such as carbolic acid, creasote, naphthol, salicylic acid, and salol. If these remedies do not give relief, absorbents may be necessary. Bismuth and charcoal are the best of this class. Drugs that aid intestinal digestion are of service. Pancreatin and preparations of a like nature relieve the symptoms. Formerly the deficiency of bile was supplied by the use of inspissated ox-gall, and it has been thought that by 5- or 10-grain doses every five hours the indications are fully met and the antifermentative and laxative effects of bile secured. The large amount of bile in the intestinal canal in health renders it quite doubtful that such small doses are of much service. The purgative effect of healthy bile in the intestine must be secured by the use of laxatives. The alkaline and purgative waters may be used, or the phosphate of sodium and drugs of a similar character may be given. Constipation must be relieved or it will become a very troublesome and distressing symptom, particularly if flatulency accompanies it.

In some forms of jaundice it is not advisable to use drugs which stimulate the secretion of bile very much. In fact, in all forms of jaundice from obstruction they should be excluded. If the purgatives suggested cannot be administered, the bowels should be opened by an enema or a glycerin suppository.

Hæmorrhages.—Hæmorrhages occurring in jaundice are an indication of the condition of the blood. They can be foreseen almost always if careful observations of the globular richness of the blood are made. They are most difficult to control, and are, in the first place, to be prevented, if possible, by healing up all abraded or

ulcerating surfaces that may be present, and by taking care not to cause any wounds. Surgical operations are not to be considered unless absolutely unavoidable. If they must be performed, they should be done before the richness of the blood is much reduced. Hæmorrhages may occur from the nose, the fauces, the stomach, and the bowels. They are to be treated by the local application of unirritating astringents, by cold, by rest in bed, injections of ice-water into the nostrils or fauces, or large enemata of ice-water into the rectum when they arise in this region. Ice may be swallowed for gastric hæmorrhage, and cold applied to the epigastrium. The internal administration of astringents, as gallic acid, astringent solutions of iron, or diluted aromatic sulphuric acid, is advisable. Rockbridge alum-water, taken internally, appeared to have had some effect in checking the hæmorrhages of intense jaundice in a case occurring in the practice of the writer. Artificial solutions of alum-water may be used for hæmorrhages that are external or in those occurring in the nose or rectum. Turpentine and hydrastis are useful, and preparations of ergot are advised. The latter drugs are usually most nauseous to patients, especially those with liver disease.

Vomiting.—Vomiting is liable to occur in many forms of liver disease. It arises usually from congestion or from fulness of the portal circulation due to obstruction of the circulation of the liver. It occurs reflexly when gall-stones are moving or attempting to move in the bile-ducts or gall-bladder. In order to relieve the symptom the patient must be properly fed with liquids. They should be frequently administered in small quantities. Lime-water should be added to milk in proper proportions, or carbonated waters may take its place. Carbonated waters, as the plain soda-water of the shops, may also be used with much advantage. Champagne will often be of service. Koumyss, whey, and buttermilk often answer if given in small quantities frequently. External applications may be used, such as mustard or any similar counter-irritant. When the vomiting is protracted a fly blister should be applied to the epigastrium. After vesication is produced the raw surface may be dusted with morphine. The choice of internal remedies depends upon the cause. If the vomiting is associated with portal congestion, it must be relieved by enemata, particularly if purgatives are not retained by the stomach. The mercurials, and especially calomel, in small doses will produce catharsis, and in that way relieve the congested stomach. The alkaline purgative salts, well diluted, are also of service. They may be frequently administered in very small quantities, as a tea-spoonful of iced liquid citrate of magnesium every ten or fifteen minutes. Equal parts of Hunyadi water and Apollinaris will often produce watery evacuations, with prompt relief of

the vomiting, but unless purgation is produced the vomiting will probably not cease. If the vomiting is due to the presence of gall-stones, of course the remedies directed to the relief of the foreign body are to be used. If the cause cannot be relieved, in addition to the blister and a selection of proper foods measures addressed to the stomach must be resorted to. The troublesome and persistent retching that attends "biliousness" and the passage of a gall-stone is relieved by lukewarm water, which causes free vomiting. Weak infusions of bitters, such as sage, produce the same effect. If there is undigested food in the stomach, an emetic must be administered. Washing out the stomach thoroughly with hot water, or with hot water in which boric acid has been dissolved in proper proportion, will often allay the vomiting. If these means fail, gastric sedatives are necessary. Small doses of morphine, given dry on the tongue, will often allay the vomiting. In combination with calomel its effect is even more marked—$\frac{1}{48}$ to $\frac{1}{24}$ grain of morphine and $\frac{1}{16}$ to $\frac{1}{12}$ grain of calomel administered every half hour. Bismuth is a useful sedative. It may be given in powder alone or combined with morphine, or the effervescing salts of bismuth may be used. Oxalate of cerium and hydrocyanic acid are also advised. Cocaine in doses of $\frac{1}{8}$ grain in solution or pill form very promptly relieves persistent vomiting in some cases. Creasote, administered in pill form, is also often of service, as is deodorized tincture of opium in doses of 2 or 3 drops every one or two hours, Alkalies are often of service, and bicarbonate of sodium or potassium or neutral mixture may be used.

Diarrhœa.—If the diarrhœa is associated with fermentation and the stools are very large and watery, it should be checked by astringents and antifermentatives. Creasote, carbolic acid, charcoal, and bismuth are often used. Alkalies, as bicarbonate of sodium alone or with pancreatin or liquor pancreaticus, may be given. Aromatic sulphuric acid in doses of 5 to 10 drops, well diluted, is one of the most serviceable astringents. Preparations of zinc, as the oxide, and of lead, as the acetate, yield good results. These remedies, if the secretion of the kidney is healthy, may be administered with opium and its preparations, or may be used alone. Diarrhœa will sometimes require purgatives to relieve it. This is particularly true if the stools are small and frequent and associated with dysenteric symptoms; alkaline purgatives, as large doses of sulphate of magnesium, are then required. Frequently relief is given by the use of a large enema given early in the day, which irrigates the colon. The water used should be hot, and an antiseptic may be dissolved in it, such as boric acid or creolin. Proper food must of course be selected.

Hæmorrhoids.—Hæmorrhoids are liable to be present in patients suffering from diseases of the liver. There is no contraindication to

surgical measures for their relief, except protracted jaundice, when hæmorrhage at the operation is likely to be excessive. We do not know whether prompt healing is interfered with by portal congestion, nor do we know whether local and general infection, in spite of antiseptic measures, is more liable to occur when the hæmorrhoids are due to intercurrent liver disease. In order to relieve them the bowels must be kept open. The patient should, if possible, have an evacuation in the recumbent posture, and a rectal bougie may be used with great comfort. After the evacuation the parts are to be thoroughly cleansed and disinfected. A small clyster of olive oil will give relief. If the bowels are not too constipated, a small amount of laudanum may be added to the oil. If the alkaline purgative waters do not produce evacuations of proper consistence, preparations of sulphur will sometimes provoke an easy movement, which gives great relief. The sulphur is to be used at night, either alone or in the combination known as compound licorice powder. Astringents, ointments, and washes are to be used when distressing symptoms arise.

Biliousness.

If premonitory symptoms prevail before the more acute symptoms arise, the attack may be averted by a saline purgative or an emetic. A glass of hot water in which Carlsbad salt has been dissolved will often clear the tongue and remove the bad taste in the mouth, particularly if proper food is taken and restriction in the duties of the day is carried out during the succeeding twenty-four hours. Podophyllin, $\frac{1}{4}$ grain, or a mercurial, as 5 grains of blue mass, at bed-time, may produce the same result. If, in spite of the measures indicated, which may be continued two or three nights, the acute symptoms develop, rest and quiet must be enjoined. Bland articles of diet, chiefly liquids, should be frequently administered in small quantities. Large draughts of lukewarm water will relieve retching, and the sipping of hot water stop the vomiting. Sinapisms to the epigastrium are of value. The excessive vomiting may also be relieved by carbonic-acid water or cracked ice. Effervescing alkaline waters are efficient if they are laxative. In minute quantities the effervescing salts of bismuth are of special advantage in some cases. As soon as purgation is secured the vomiting generally ceases. Often, sedative doses of calomel, just large enough to act upon the bowels, can be given, and $\frac{1}{8}$ or $\frac{1}{6}$ grain every half hour or hour, dry on the tongue, is generally efficient. It may be combined with small doses (1 grain) of subnitrate or subcarbonate of bismuth. In some cases with restlessness minute doses of morphine may be added. Indeed, $\frac{1}{16}$ to $\frac{1}{10}$ grain of calomel and $\frac{1}{48}$ to $\frac{1}{32}$ grain of morphine, dry on the tongue, is the

best remedy for vomiting the writer has used. If there is headache caffeine may be added to the calomel in $\frac{1}{4}$-, $\frac{1}{2}$-, or 1-grain doses. Lately acetanilid has seemed to be of advantage. It does not nauseate, and in 1- or 2-grain doses soon relieves the pain. The purgative action of calomel may be aided by an enema or glycerin suppository.

Some patients crave an acid when suffering from biliousness. The aromatic sulphuric acid, in doses of 2 or 3 drops in a table-spoonful of aniseed-water or cinnamon-water given every half hour, will be found to be grateful. A drop of deodorized tincture of opium may be added, and augments the sedative effect of the acid. The foregoing remedies are of service after the bowels have been moved by a purgative or if a symptomatic diarrhœa attends the attack.

In some cases neutral mixture or the officinal solution of citrate of potassium in $\frac{1}{2}$-ounce doses checks the vomiting. Equal parts of the latter and paregoric in a dose of 1 or 2 drachms is a favorite prescription with the writer.

Lime-water alone or added to milk is used frequently. Milk diluted with lime-water or carbonated water and administered in small quantities allays thirst and vomiting. Stimulants may be necessary. Small amounts of fine brandy or good rye whiskey added to lime-water, if iced, are often grateful. Champagne is also very good.

When the symptoms of biliousness are less acute and more protracted, the diet must be regulated in accordance with the principles of the dietetics of liver disease. The drugs to be used are those which increase the action of the liver and relieve portal stagnation by producing a movement of the bowels each day. Alkalies are the best, and the alkaline purgative waters or salines dissolved in large amounts of water soon remove the disagreeable symptoms. The writer usually selects phosphate of sodium, and has seen the state of biliousness removed by the use of this drug dissolved in hot water and sipped slowly at bedtime. In more severe cases it may also be taken in the morning before breakfast. Carlsbad or Saratoga Vichy salts in the same way are also of service. The vegetable hepatic stimulants may answer instead, and indeed have been of service when alkaline waters could not be taken.

It is of great advantage to combine an alkali with a vegetable cathartic, and in cases of biliousness in which the patient is liable to acute exacerbations bicarbonate of sodium and salicylate of sodium, alone or together, combined with rhubarb in tincture or with infusion of gentian, given before meals have been of service to the writer. The dose of rhubarb is such as to ensure one or two evacuations of the bowels each day. Instead of the bitter, for children an aromatic syrup may be used as the excipient. The writer is satisfied that an alkali administered in this way is of much service in cases of biliousness

which occur in persons of phlegmatic temperament who are overweight and leading a sedentary life without much strain or excitement.

The mineral acids are of decided advantage in biliousness, particularly if associated with abundant discharge of urates and uric acid. For this purpose nitro-hydrochloric acid and dilute hydrochloric acid have served the writer well. They should be given after meals, well diluted, and may be combined advantageously with a bitter, as nux vomica in small doses. It has seemed to the writer that persons of spare build, of dark complexion, engaged in a sedentary occupation with much worry, are best relieved by acids. They are also indicated, according to Ringer, if there is headache situated along the eyebrows.

At the same time, drugs which aid gastric and intestinal digestion or which allay the distressing symptoms must be used. Preparations of pepsin and pancreatin are required. The vegetable bitters or mineral acids, bismuth, carbolic acid or creasote, charcoal, and similar drugs, are to be used if indications require them.

Patients who can do so are always benefited by a course of waters at any good "cure," while a life in the woods, a sea-voyage, travel, or light occupation, if carried out in accordance with hygienic rules, removes all traces of sluggishness of the liver.

The administration of drugs is the least important element in the cure of biliousness. Attacks must be prevented and the tendency removed by a properly-regulated life. If the diet is selected in accordance with the rules previously indicated, it will aid much. Proper exercise must be taken, occupation inquired into, hours of work and rest regulated, systematic bathing directed, and, in fact, the life of each day conducted in a strictly hygienic manner. In children the best results are seen if the patient is properly managed. In accordance with the foregoing their life must be regulated, and in addition the proper development of all the functions should be aided. Their muscular system must be developed and the skeleton strengthened. Proper attention must be given to the eyesight. Often the evolution of the naso-pharyngeal structures is overlooked. An excess of lymphoid tissue, as seen in adenoid growths in the naso-pharynx, interferes with development, curtails breathing, requires hurried eating, and hence disturbs digestion and interferes with nutrition. In the writer's hands the removal of such growths has been followed by as striking results as are seen when proper glasses are fitted to a sufferer from a refraction error. Outdoor life, bathing, gymnastics, exercise, and proper food and hours for sleep will produce remarkable changes for the better.

Fatty Liver.

Fatty degeneration of the liver dependent upon disease of other organs requires for its treatment the relief of such disease if possible,

or an attempt to counteract the debilitating effects of the disease. The general health of the patient demands attention, and with the removal of the cause, tonics and stimulants and out-door life, with well-regulated, highly-nutritious diet, and all measures to promote the general health, must be resorted to. Fatty infiltration of the liver, or the fat liver, as it may be termed, like the fatty heart, is usually associated with general obesity and an increase of fat in other organs. The presence of fat in the liver is not as serious as its presence in other situations; as, for instance, in the heart. The treatment, therefore, of fatty liver is the same as advised in the treatment of obesity, the method selected being dependent upon the cause of the obesity and the condition of the heart and arteries of the patient. The methods of Oertel, Banting, Ebstein, Schwenninger, and others are of avail. In the use of these methods reduction of the amount of food is insisted upon and plenty of exercise ordered. Oertel also reduces the quantity of fluids. All of these authors allow a mixed diet, with the exception of Banting, who orders an exclusive albuminous diet. Ebstein permits the fats to be taken, but requires a reduction in the starch and the saccharine foods. In proper cases purgatives may be used, and especially in the form of mineral waters. Oertel, however, advises against the use of the Carlsbad waters or the "cure" at Carlsbad. The Marienbad waters are advised by Kisch, but it is to be remembered that an anæmic patient would be prostrated by such a course, while a plethoric one would be improved. Graduated exercise, of course, must be allowed, the amount dependent upon the condition of the heart. Such exercise gradually strengthens the heart-muscle and increases its function. In grave cases it should be attempted only in the strictly accurate manner laid down by Oertel. The circulation in the right heart and pulmonary vessels is increased and the general circulation benefited thereby. The portal circulation, particularly, would be stimulated by proper exercise by gymnastics and properly-directed massage. Drugs are not of much service. Preparations of arsenic may be used, and iron, if the patients are anæmic, is always of service.

Congestion of the Liver.

Active hyperæmia of the liver is seen more particularly in hot climates. It follows the abuse of stimulants. Rich food and alcoholic drinks must be avoided, and checking of the perspiration prevented. A repetition of the attack, so liable to take place, can be prevented by these means. The diet must be simple. Milk, broth, beef-essence, and the most easily digested semi-solids must be employed. Active hyperæmia, if attended by pain, may require local bloodletting, as by cups or leeches. The latter may be applied to the anus. Deple-

tion can sometimes be secured by active purgation with salines. A warm bath at the time of the attack is of service. Sinapisms, followed by large poultices of flaxseed or cloths wrung out of hot water, with or without turpentine, give great comfort. Some internal remedies appear to relieve the congestion. Alkalies, chloride of ammonium, and ipecacuanha are highly spoken of. Mercurials are not resorted to. Effervescing alkalies may be administered before meals with a weak bitter infusion. Bicarbonate of sodium, with taraxacum, is often prescribed, and Carlsbad, Vichy, and Bedford salts are valuable. Chloride of ammonium is considered by some almost a specific. Large doses are administered frequently, and in twenty-four or forty-eight hours the acute symptoms disappear. Ten grains of the drug may be given every two hours, largely diluted, or 20 grains at intervals of four hours until six doses have been taken, when the amount may be reduced. McLean has called attention to the value of ipecacuanha. Large doses alone are of service; 15 to 30, or even 40, grains are administered, care being taken not to provoke emesis. In order that this may be prevented, the patient should lie down and precede the doses of ipecacuanha by 10 drops of deodorized tincture of opium, and at the same time a mustard plaster should be applied to the epigastrium. The ipecac should be repeated in three hours, and after the second dose relief is usually secured. If not, a third dose may be taken.

Chronic Congestion or Chronic Hyperæmia of the liver requires treatment with two objects in view: first, to remove the cause; and second, to deplete the engorged liver. In order to secure the first, the circulation must be carefully studied. Lesions of the heart which produce venous stasis must be overcome if possible: digitalis is therefore to be used in full doses until the dilated heart responds to treatment. Other cardiac tonics are likewise of service. Saline cathartics, as the sulphate of magnesium or the saline purgative waters, must be judiciously administered. The congestion may be due to disease of other organs within the abdomen or arise from the pressure of growths or hypertrophied organs. If possible they should be removed. Malarial congestion requires for its treatment the use of proper antiperiodics, of saline purgatives, counter-irritation or frequent cuppings, and even occasional leechings, over the liver or about the anus. A certain amount of anæmia is frequently present, and must be treated in the usual way. Arsenic meets several indications when used cautiously: the chronic malaria, the poor digestion, and the weak heart are benefited. The general indications concerning diet and exercise previously mentioned must be carefully attended to. When congestion of the liver is followed by atrophy or by the "nutmeg" liver, symptoms of portal obstruction arise, as in cirrhosis.

The treatment detailed in the section on the latter disease and in the discussion of Ascites, etc. is applicable to atrophy and "nutmeg liver." Pigment liver is due to congestion, with deposition of hæmatin in the vessels and secondary interstitial hepatitis. The treatment is evident from what has already been said.

Amyloid Degeneration of the Liver.

There are no drugs which have any influence on amyloid degeneration, although at one time it was thought that alkalies administered freely had a decided effect upon the condition. The cause must be combated in the management of amyloid disease, and its baneful influence removed if possible. Suppuration must therefore be checked, bone diseases treated actively and as early as possible, and syphilis and tuberculosis treated in accordance with the well-known methods for their limitation. It should not be forgotten by surgeons who hesitate in the performance of operations that the continuance of chronic suppuration or of any chronic necrotic process is liable to be attended by amyloid degeneration. Imminent danger from this cause, therefore, urges to early operation.

Iodine is said to be of service in amyloid disease. Murchison advises the administration of the tincture in doses of 10 or 15 minims, diluted, three or four times a day. No doubt cases of amyloid disease are benefited by this drug, but it is not likely that the degenerative process is checked.

The general rules regarding diet, habits, and exercise that pertain to all forms of hepatic disease must be enjoined, as far as practicable.

In the course of amyloid disease of the liver complications will arise and demand attention. The disease is likely to cause most obstinate vomiting and excessive diarrhœa, both of which are difficult to control. For the vomiting counter-irritation over the epigastrium may be used, and bismuth and hydrocyanic acid administered internally. Cocaine appeared to be of service in one of the writer's cases. Whether to check the diarrhœa or not is always a problem, because albuminuria is generally present. Opiates must be used under these circumstances with great caution, and even with care uræmia may occur. Large doses of bismuth and aromatic sulphuric acid may be given, and hot fomentations and counter-irritation used upon the abdomen.

Hydatid Cysts of the Liver.

The treatment of hydatid cysts is preventive, symptomatic, and curative. Care should always be taken by those who are among dogs and other animals to avoid contracting the disease.

The symptoms which require relief are usually due to pressure or

to local inflammation, indicated by pain. In multiple hydatid cysts, jaundice and ascites are the symptoms which demand the attention of the therapeutist.

At one time it was thought that medicine by the mouth would cause destruction of the parasite, followed by absorption of the cyst. Chamomile alone or with bromide of potassium was advised; turpentine was administered by others; iodide of potassium has been vaunted; and Davine thought he obtained some good results from salts of mercury. The argument against the administration of drugs is that by disturbing the intestinal canal risk of rupture from vomiting or diarrhœa is increased.

It does not seem probable that internal remedies can be so absorbed and taken up by the cyst as to influence the life of the parasite. If any curative treatment is advisable, operative measures of some form should at once be decided upon. Various method are advocated, but tapping and free excision have the support of most men of experience. The injection of medicated fluids and the use of electricity are not without advocates. Tapping may be done with a trocar and canula, or by means of aspiration with the Dieulafoy apparatus, which is usually employed. The advocates of puncture of the cyst believe that it is the simplest method and attended with the least danger. Of course if suppuration has taken place in the cyst no cure can be brought about simply by tapping or aspirating. Surgeons who oppose tapping or the use of the aspirator believe that serious results sometimes follow this method. There is no doubt that in a measure one is striking in the dark when the needle is plunged into the region in which a hydatid cyst is situated.

Graham in his recent work on *Hydatid Diseases* relates a number of cases which died a short time after tapping. In one case the cause of death could not be found at the post-mortem examination; in another, sudden cough on the introduction of the needle led to rupture of the cyst into the lung, with hæmorrhage which filled the whole left lung. In two of his patients tapping had to be immediately followed by free incision, because of the onset of alarming symptoms. It is fair to state that in both these cases the cyst was in the lung. Graham states, however, that he has frequently noticed, after evacuating an abdominal hydatid, troublesome and intense symptoms, such as vomiting, severe pain, high temperature, and a rapid pulse persisting for several days. He does not believe that this is due to peritonitis, but that either absorption of the fluid had taken place or else the symptoms were reflex in their character. In the very limited experience of the writer aspiration with antiseptic precautions was not followed by grave symptoms, and resulted in cure in two patients, a child and an adult. It is thought that in the process of cure after tapping the cyst-walls

collapse and fall away from the adventitia; an exudation of serum then takes place as the new cyst forms, while the cyst-wall becomes a suppurating mass, breaking down into an amorphous débris. Some authors believe that it is necessary to evacuate only a small amount of fluid.

Graham advises the physician not to allow the patient to go out of his care until some time has elapsed, as there is danger of suppuration. Fagge recommends that a year of quiet should elapse after the cyst has been tapped, in order that suppuration may not be set up. It has just been mentioned that it is uncertain what is touched by the exploring needle when it is introduced in the hepatic region. The dangers that may arise from tapping are increased often because of the difficulty of localizing the cyst. The cyst may be either directly beneath the diaphragm, behind the pendent lobes of the liver, or in the median line near the suspensory ligament. For these reasons, while exploratory puncture in certain regions is simple and apparently free from risk, tapping operations are not to be generally advised in the treatment of hydatid disease.

Direct incision and evacuation of the contents of the hydatid is certainly the most rational method of treatment. The operation is performed as are other abdominal operations. Lindemann is said to have performed the first operation in 1871. He stitched the cyst-wall to the abdominal parietes, and his patient made a rapid recovery. Tait makes an abdominal incision, aspirates the fluid, then opens the cyst, and stitches its edges to the external wound. Simons operates differently. He first inserts a fine trocar and canula, and withdraws the canula to verify the diagnosis. He then inserts a larger instrument, which allows some fluid to escape. He keeps this in position, and applies an antiseptic dressing. The plugs in the canula are removed at intervals of a few days in order to study the character of the disease. As soon as pus is found inflammatory adhesions have resulted, and he then cuts directly into the cyst. This method is tedious, and even uncertain as a means of procuring adhesions.

If the direct incision is decided upon, the most prominent part of the tumor is selected, and an incision two inches long is made to the surface of the peritoneum. The further technique is the same as the operation for ovarian tumors, care being taken to attach the edges of the cyst to the abdominal incision and not to allow fluid to escape into the abdominal cavity, After the cyst is stitched to the wound it is opened with a knife and the finger inserted. The contents are thoroughly evacuated and the daughter-cysts are removed by curetting. The cyst must be completely emptied. Anything like force must be avoided, as bleeding may result from the pericystic connective tissue. After the contents are evacuated a drainage-tube is

inserted and the wound dressed antiseptically. The method of direct incision has also been performed in two parts: First incise down to the peritoneum and plug the wound with serum gauze. In about a week adhesions are formed. The cyst is then opened with a knife, as in Lindemann's operation. Barwell has advocated this method in England. Graham argues that it has no advantage and necessitates the shock of two operations, while adhesions are not always procured. Cysts that grow on the upper surface of the liver must be reached by removing the ribs at the most dependent part. Care must be taken not to allow fluid to escape into the pleural cavity. Usually a counter-opening must be made in order to favor drainage. The cyst after operation should be frequently syringed with a few drops of iodine and water or a bichloride-of-mercury solution, care being taken not to inject the fluid forcibly.

An article by Fagge and Durham in 1871 called attention to the use of electricity in the treatment of hydatid cysts, but the report of their cases in which complete cure was claimed has not been followed by enthusiastic reports of other operators. The needles were electro-gilt and introduced into the cyst a few inches, and were made to touch each other when inserted. The negative pole of the galvanic battery was attached to the needles, while the positive pole terminated in a sponge, which was rubbed over the tumor. The current was allowed to pass for ten minutes. The advocates of this treatment believe that the saline solution in the cyst is decomposed, and that the parasite in consequence loses its vitality.

A large number of materials have been injected into the cysts. Iodine seems to have been the favorite, carbolic acid next, and finally a solution of bichloride of mercury and carbolic acid. Pover recommended a mixture of $\frac{1}{2}$ drachm each of fluid extract of male fern and liquor potassii. Batchelli used a strong solution of bichloride of mercury, and permanganate of potassium is said to cure cases of hydatid cyst with daughter-cysts if injected into the cavity.

Acute Yellow Atrophy of the Liver.

This peculiar affection, rare and always fatal, is unfortunately of no interest to the therapeutist who is anxious to secure good results. There are no remedies or methods of procedure which will stop the progress of the disorder or even relieve any of the symptoms. Whatever treatment is used must be entirely symptomatic. The vomiting that occurs will require attention; hæmorrhages may be checked; if possible the pain, which sometimes is complained of, relieved in a partial manner; and exhaustion and prostration treated by stimulants. In pregnant women it is barely possible that the induction of labor might be of service if performed sufficiently early, and yet the dangers from uterine

hæmorrhage would make the procedure most grave. If the blood should not show much reduction in the number of red corpuscles and the operation were resorted to early, it might be of service. If the red blood-corpuscles are destroyed, certainly fatal hæmorrhage will ensue, and therefore it is scarcely worth while to interfere. Attempts might be made also to invoke the action of the skin, and thereby relieve the congested and degenerated kidneys. The renal organs should also receive attention and their functions be excited if possible by cups and fomentations. The cases which the writer has seen did not respond to any treatment whatsoever, except that pain was relieved apparently by anodynes. Of course these cases have led the writer to insist upon the induction of labor as soon as the diagnosis of acute yellow atrophy of the liver is made, with the hope that by removing the predisposing factor of pregnancy life may be saved.

Acute Localized Hepatitis or Abscess of the Liver.

Multiple abscesses of the liver, pyæmic abscesses, or emboli and tropical abscess will be considered together. Although, in accordance with our classification, they belong to another section, space is saved by considering them here. Pyæmic abscesses are not curable The symptoms which accompany the affection alone can be treated. Pain and tenderness must be relieved by local applications of heat; large poultices or hot cloths will be found to be of comfort. Anodynes must be used in accordance with the circumstances of the case. Jaundice generally does not require much treatment, as it is often due to a morbid condition of the blood. If the inflammation is due to the presence of gall-stones, the jaundice is more intense, and is to be treated in accordance with the principles laid down in an earlier part of this article. For the constitutional symptoms quinine and the mineral acids are to be used. Stimulants of course will be necessary. Other symptoms that arise, such as vomiting and diarrhœa, will require attention. The diet must be nutritious and abundant.

Even in cases of multiple abscess surgical methods of relief are sometimes necessary. Aspiration may be required with the hope of relieving symptoms; permanent good would, of course, not ensue. Multiple abscesses that result from dysentery should not deter one from an operation. If the operation is properly done and proper drainage secured, it will do no harm and may result in cure. The presence of two or more abscesses does not necessarily compel us to withhold our hands, as any number may be operated upon and drained simultaneously.

Tropical abscess of the liver requires treatment differing in character in the two stages of the disease. In the first stage the treatment is not unlike that of congestion of the liver. Dietetic and hygienic meas-

ures must be employed. Local applications and remedies for the relief of pain are to be given, such as chloride of ammonium, ipecacuanha, and saline aperients. They are administered by the methods advised in congestion of the liver. Should the congestion of this form of hepatitis not be relieved and suppuration take place, a different plan is required. The pain and local discomfort will require local applications of heat and moisture and the use of sinapisms or blisters. The fever must be treated in accordance with the usual methods for the treatment of hectic, and the strength of the patient must be kept up. Nutritious food, not too stimulating, must be given, and quinine and the mineral acids used. The presence of pus can be accurately determined only by the aspirator.

Puncture of the liver for this purpose is not generally attended with danger. A long, fine needle attached to the end of the ordinary aspirating apparatus of Bowditch or Dieulafoy may be used. The puncture should be made at the most prominent or swollen part, particularly if it is œdematous. When on the right side, the needle should be thrust upward to the left; and if in the left side, its point should be directed obliquely to the right. The needle should then be withdrawn slowly. If pus is present, a drop or two will be found in the canula or on the point of the needle. The absence of pus does not necessarily signify the absence of an abscess. Sometimes the material forming the abscess is so thick that it will not become attached to the exploring needle, or the abscess may not have been reached. Repeated punctures are not harmful, and may be required before the question of abscess is definitely settled. Instead of harm being done, there are quite a number of cases on record in which the symptoms were benefited by puncturing. If pus is obtained, further procedures will depend upon the position of the abscess and its size. If near the surface and of large size, it should be opened freely with the usual antiseptic precautions. An antiseptic solution should be used to wash it out and proper drainage instituted. If the abscess is presumably very deep, in opening it the danger of hæmorrhage from the tissue of the liver must be considered. In these cases it is probably better to aspirate with a large canula, through which drainage material can be conducted to the wound. Such aspiration should not be performed if the abscess can only be reached through the pleura behind. Under these circumstances it is better, after cutting down on the pleura, if adhesions have not formed, to stitch it by a double row to the diaphragm and then open freely with a bistoury. If the abscess is anterior, adhesions of the peritoneum to the liver are of advantage; if not present, the walls of the abscess could be stitched to the peritoneum and then opened.

If the abscess has ruptured into the lung or pleura, or, in fact, into

any of the neighboring structures, it should be opened and drained as early as possible. If there seems to be deep-seated suppuration which is not likely to open into important parts, and if the patient is not losing ground, the surgeon may wait a few days until the pus is in a more favorable situation. Otherwise, as soon as the presence of pus is determined the operation for its removal should be done.

Cirrhosis of the Liver.

No doubt the early stages of this disease are amenable to treatment if the habits of the patient are fully under the control of the physician. In all probability the stage of congestion which is thought to precede an overgrowth of the connective tissue may be removed. Treatment with this end in view is similar to the treatment of congestion of the liver. In addition to regulation of diet and habits, the use of alkaline, purgative, and diuretic waters is recommended; occasionally local depletion is used. The administration of iodide of potassium is looked upon with favor by some. Chloride of ammonium, administered in large doses, is also useful, and often the enlarged and congested liver, the first stage of cirrhosis, which is indicated by the habits and associate symptoms, diminishes rapidly when this drug is administered. Some practitioners give small doses of mercury, while others advise external applications of the drug. The green iodide of mercury, administered three times a day in $\frac{1}{2}$-grain doses, appears to act as a resolvent according to the testimony of some authors, and at the same time relieves the overloaded portal circulation.

The writer has full confidence in the importance of stopping the use of stimulants and in depletion. He is not, however, satisfied as to the curative effects of iodide of potassium, although, as it is advocated by high authorities, the drug should be given a fair trial. It may be administered by the method indicated in the section on the Administration of Drugs. A course of waters at Carlsbad or Vichy, at Bedford or Saratoga, with a proper regimen, may relieve the first stage. The course should be repeated annually for a few years. If the disease has gone on to the stage of overgrowth of connective tissue, there are no remedies of any service. The measures resorted to must have for their object diminution of the congestion which is present, thereby avoiding further proliferation of connective tissue. Dietetic means, of course, are necessary to bring this about. The liver must be relieved from the performance of its functions as much as possible, and hence starchy foods, sugars, and fats must be diminished in amount or withdrawn entirely. Stimulants or highly-seasoned dishes of course are not to be allowed. In order to reduce the congestion, the portal circulation must be relieved by means of alkaline purgative waters, as Carls-

bad water, Hunyadi water, Friederichshall water, and the Saratoga or Bedford water of this country. If after these measures the disease progresses, attention must be paid to the congestion in the portal area of the circulation, and measures used which will lessen the deleterious results of such congestions in the abdominal viscera. In the earlier sections of this article the treatment of these congestions was referred to.

The gastric and intestinal catarrh, the gastro-intestinal hæmorrhages, hæmorrhoids, and ascites, are treated in cirrhosis of the liver just as they are treated in other affections of the organ in which the portal circulation is obstructed. The condition of the skin and kidneys must of course be looked after most carefully. Tonics and measures to keep up the strength of the patient are required. The mineral acids, quinine, nux vomica, and other bitter tonics, serve a good purpose, and in the course of the disease may be alternated from time to time. In the later stages of the disease it is necessary to administer stimulants. Prostration is so great and digestion so poor that without stimulating the mucous membrane of the stomach digestion cannot be carried on, while the prostration of course cannot well be relieved by other means. It is necessary, therefore, to relax the regulations regarding the use of alcohol, and spirituous liquors or wines must be ordered. Any one who sees a case through a long period of time will readily understand how necessary it is to administer stimulants in the later stages.

In the latter stages of hepatic cirrhosis a cachexia develops which requires most careful hygienic treatment, including the use of stimulants. In the cachexia the nutrition of the skin particularly suffers. It should be kept well oiled, as it is liable to become dry and scaly, and bed-sores or low-grade inflammations and ulcers are likely to develop. Pressure-points must be kept dry by powders and stimulated by friction. Cleanliness of the patient must be insisted upon, and local inflammatory areas prevented by proper bedding and clothing. As a summary of the treatment of cirrhosis of the liver we may say that the following measures are necessary: regulation of the diet; attention to the functions of the skin and kidneys; treatment of symptoms due to portal congestion; attention to gastric and intestinal digestion; an occasional use, therefore, of calomel associated with bitter tonics, particularly after indiscretion in diet or work, when the tongue becomes heavily coated, the appetite is lost, bowels costive, and stools clayey; and the administration of the mineral acids, bitter tonics, and stimulants when indicated.

Syphilitic hepatitis is to be treated in accordance with methods established for the treatment of the latter stages of syphilis. The iodides are to be given freely, alternating with or combined with tonic courses of mercury. Tonics are to be used when required. Proper

diet is to be selected and general hygiene regulated. Tubercular hepatitis or tuberculosis of the liver does not require treatment directed to that organ particularly.

Leucocythæmia will be considered elsewhere in this volume.

Thrombosis of the Portal Vein.

If occlusion of the portal vein occurs, ascites and congestion of the vessels in the gastro-intestinal tract, with subsequent catarrhs, hæmorrhages, and other symptoms of portal congestion, are also present. Treatment which ameliorates the symptoms should be resorted to: to remove the cause is scarcely to be hoped for.

If suppuration exists, efforts should be made to lessen its effects by tonics and stimulants. Otherwise, drugs will not be of service, and may prevent the good results of stimulants, food, and rest.

Acute Catarrhal Inflammation of the Gall-ducts.

At the beginning of an attack of acute catarrh of the gall-ducts liquid food that is not stimulating is required. Diluted milk or milk and lime-water, peptonized milk, whey, buttermilk, beef-tea, animal broths, and "slops" generally are required. As the attack subsides more solid food may be used. Oysters, white meat of chicken, a finely-minced steak made into a paté, and broiled sweet-bread, gradually passing on to other meats, eggs, fish, and easily-digested, succulent vegetables, may be used.

The patient should be put to bed and kept warm. Warmth should be applied particularly to the extremities. Mustard plasters, or even more active counter-irritation, to the epigastrium and right hypochondrium are necessary.

Sedatives to relieve vomiting, as in biliousness, are to be used. Calomel or alkaline draughts to secure purgation should be given in the first twenty-four hours. The bile is retained in the liver by a very slight obstacle. The pressure which causes it to pass out in health is very small; if this pressure be increased, the plug of mucus or other obstacle in the biliary canal may be removed. An emetic will have this effect. A sufficient dose of ipecacuanha or $\frac{1}{4}$-grain doses of tartar emetic, given every hour in a large amount of hot water until emesis is produced, will often relieve the obstructive jaundice.

Drugs which liquefy the bile and at the same time increase secretions from mucous membranes or dissolve mucus are indicated. Of these, phosphate, bicarbonate, benzoate, and salicylate of sodium are the best. At first the drug which is used may be combined with calomel in small doses, and afterward given alone freely diluted. Alkalies may be given with taraxacum in decoction or in pill or capsule, followed by large amounts of hot water. Chloride of ammonium is another

drug of great service: 5 grains every two or three hours, masked by licorice or by simple syrup, may be given. It can also be given in capsule, compressed pill, or cachet. If the bowels have been freely opened and the jaundice does not show signs of disappearing, nitrate of silver may be used. It should be given in pill form and on an empty stomach.

Ipecacuanha in small doses as an hepatic stimulant is advised by many writers. It should be given after the nausea and vomiting of the first period of the attack have passed off; $\frac{1}{4}$ to 1 grain every two or three hours is sufficient. It may be combined with nitrate of silver if that drug is given. Hydrastis is much employed in certain parts of this country under similar circumstances. In more protracted cases nitric acid is often of service, and the acid pack over the liver or the general acid bath may be used. The method of Krull has been advocated during the past five years, and the writer has observed some cases that were rapidly relieved by it. From 1 to 4 pints of water, at a temperature of 59° F., are slowly injected into the rectum once daily. It must be retained as long as possible. On subsequent days the temperature of the water is gradually raised until it is injected at 72° F.

Other methods for the relief of the jaundice have been advised. When the gall-bladder is enlarged and accessible, its compression must be very gradual, and in some cases the patient improves by relief to the obstruction and hence diminution of the inflammation. Some high authorities recommend faradization of the gall-ducts.

It is not to be forgotten that some cases of acute catarrh of the ducts are of malarial origin, and require quinine and arsenic.

Catarrhal inflammation of the ducts, if due to syphilis, must be treated accordingly. Often it is of gouty or rheumatic origin, and in such cases Murchison recommends the use of colchicum in addition to alkalies in suitable doses.

Chronic Catarrhal Jaundice.

In cases of chronic catarrhal jaundice proper dietetic and hygienic regulations are to be ordered. Malaria, heart disease, or any removable cause must be attended to. Mild counter-irritation should be used. Hot water in large amounts, or Carlsbad, Saratoga, or Vichy water, may be given.

Phosphate of sodium and chloride of ammonium must be given for a long time. The prolonged use of the nitrate of silver seems to be of the greatest value. The extract of belladonna may be added, and $\frac{1}{8}$ to $\frac{1}{4}$ grain of each given before meals.

The mineral acids and the acid pack are advised by many, and their use has been followed by cure. This variety of jaundice receives bene-

fit at springs and baths. The waters of Carlsbad, Marienbad, Vichy, Saratoga, and Bedford are almost always beneficial in cases of uncomplicated chronic catarrh of the ducts.

Adhesive Inflammation of the Bile-ducts.

Adhesive inflammation of the ducts, with or without stricture, which has followed the passage of a gall-stone or the healing of an ulcer, can only be treated symptomatically. If the gall-bladder is enlarged, it is possible that the stricture is below the cystic duct, and a cholecystotomy or cholecystenterostomy may give relief by establishing an outlet for the bile.

Occlusion of the Gall-ducts.

If the cause of occlusion of the ducts can be ascertained, its removal, if possible, is necessary. The removal of gall-stones will be considered in another section.

Acute and suppurative inflammation of the ducts can only be treated by removal of the cause. If a gall-stone or other foreign body has excited the inflammation, its removal with proper drainage will cure the patient. Otherwise, the pain, hectic fever, and jaundice can only be treated symptomatically.

It is to be remembered that such occlusion may sometimes be due to the pressure of accumulated fæces in the colon.

Carcinoma.

In this outline of diseases carcinoma is placed under Diseases of the Ducts. Primary cancer without doubt always originates in the ducts. The secondary variety does not differ in symptoms from the primary.

A few words only are necessary in the discussion of the treatment of cancer and other tumors of the liver. The treatment is that of the complications, of which local hepatitis, gastro-intestinal congestions, ascites, and jaundice are the most important. The pain will demand local counter-irritation, occasional blisters, and the internal use of opium. The remaining complications are discussed in other sections.

Gall-stones.

A discussion of the treatment of a patient subject to gall-stones must include—first, the treatment of the habit which predisposes to their formation (cholelithiasis); secondly, the treatment of an attack of biliary colic; thirdly, the treatment of the stones in the ducts or bladder —(*a*) when free from symptoms; (*b*) when they cause occlusion of the biliary passage or set up suppurative inflammation.

In order to prevent the formation of gall-stones, dietetic and other hygienic means are necessary. Fatty and saccharine articles of food,

rich food, and malt liquors must be interdicted. Exercise in the open air must be insisted upon, especially such forms as increase the strength of the abdominal and respiratory muscles.

If the patient's occupation is sedentary he should change his position frequently. Sitting and standing should alternate. In women particularly improper habits of sitting should be corrected, and the wearing of corsets and other tight clothing forbidden. If by reason of some other ailment they have not taken exercise sufficient for the wants of the body, the ailment of course should be first corrected : this refers more particularly to uterine disease. In many cases it is quite necessary to teach patients how to exercise, or rather to make them appreciate how little exercise they really take. It is surprising how, through the force of long habit, many women will be content to keep in-doors, and, practically, almost in one position. Indeed, the physician must preach the gospel of exercise, diet, and general hygienic care in cases of this character, as in many others, with an enthusiasm equivalent to that needed, as many think, for the saving of souls.

The bile should be made thinner and its movements through the ducts hastened. To secure the former, large quantities of water should be taken. It should be very hot and swallowed slowly and at night. Carlsbad Sprudel salts dissolved in the water, the Vichy or Saratoga salts, phosphate or salicylate of sodium, are important and almost essential adjuncts. If the patient is constipated, the above-mentioned salines and alkalies are particularly necessary, and may be used with other purgatives and hepatic stimulants. The use of alkalies not only prevents the formation, but seems to dissolve or aid in the dissolution, of the concretions. In order to secure a discharge of bile the characters of which do not favor the formation of calculi, the long-continued use of salicylate of sodium is advised.

For the class of cases under discussion a course at the saline springs is of great advantage. If the patient is careful subsequently, the formation of the stones may be permanently prevented. The springs should be selected in accordance with rules previously indicated ; suffice it to say that the Carlsbad and Vichy abroad, and the Saratoga and Bedford in this country, are the best.

Biliary Colic.—The passage of gall-stones always requires medical attention. Pain and collapse, vomiting and perhaps jaundice, are the symptoms demanding relief.

For the pain local applications—poultices, hot cloths, the hot-water bag, and mustard plasters—are useful. Local depletion is not necessary unless a local inflammation arises. The general hot bath may give great relief through the relaxation it produces, whereby the passage of the stone is favored.

Opiates are generally necessary ; morphine may be administered by

the mouth or by hypodermic injection. If given hypodermically, atropine may be added to it with great advantage; $\frac{1}{4}$ grain of morphine and $\frac{1}{120}$ grain of atropine in a robust subject will be sufficient. The injection may be repeated in half an hour. The morphine should be given by the mouth in small and frequently-repeated doses unless the pain is excessive. Opium may also be given by the rectum, either by suppository or enema—$\frac{1}{2}$ grain of the extract—and the same dose of belladonna gives relief. Ringer advises gelsemium; 5 drops of the tincture are to be given every fifteen minutes. If the patient walks about, relief may follow sooner.

If the above-mentioned drugs are not sufficient, inhalations of chloroform or ether may be required. Neither of these drugs can be given internally, on account of vomiting.

To relieve the pain and favor the passage of the gall-stone, sipping hot water made alkaline with bicarbonate of sodium may be of advantage.

Vomiting is a most distressing symptom. It may not be relieved until the full effect of the anodyne is produced. Alkaline waters, hot or effervescing, are of advantage. Cracked ice in small particles may be swallowed, and measures suggested in the preceding section tried.

If the stone does not pass through the common duct—which may be determined by an examination of the stools—it will remain either in the gall-bladder or in one of the ducts. In this situation no symptoms may indicate its presence, but it is desirable to get rid of it and prevent the formation of others. The methods to prevent the formation of stones have been described. To remove existing stones, solvents, as chloroform and turpentine, have been used, but they are not worthy of further trial. More can be expected from alkalies and salines when largely diluted and hot, combined with a regimen of diet and exercise like that followed at Carlsbad. It is thought that olive oil, in $\frac{1}{2}$-ounce or 1-ounce doses three or four times a day, will move the calculus. Particles of fat in the stools must not be mistaken for cholesterine bodies. If a solitary stone remains in the gall-bladder or duct, gentle compression on the enlarged gall-bladder may cause its expulsion.

If, in spite of these measures, the stone is fixed and grave symptoms of obstruction arise, surgical measures must be resorted to.

DISEASES OF THE SPLEEN.

With rare exceptions, affections of the spleen are either secondary disorders or occur conjointly with diseases of other organs. The spleen

may be the seat of acute or chronic congestion or inflammation, of infarction, of lardaceous degeneration, of carcinoma, and of hydatid disease. Hypertrophy of the spleen is frequently seen, but is almost always associated with leucocythæmia, the treatment of which is discussed in the article on Diseases of the Blood.

As the affections of the spleen are usually secondary, the reader must look to the appropriate articles for an account of the therapy of particular diseases. It is sufficient to say that the therapeutic management of affections of the spleen is not dissimilar to the management of similar affections in other organs. The removal, if possible, or treatment, of the cause is primarily to be attended to. Then hygienic measures or therapeutic methods are to be used which will lessen congestion of the organ, and hence congestion or over-fulness of the portal circulation must be removed. Congestions and inflammations, which often result in suppuration, degenerations, and other processes, require the local and general treatment applied to such morbid processes.

It may be worth while to remark that in acute affections of the spleen—acute congestion, acute inflammation, and recent infarcts—the organ should be manipulated with the utmost care and as infrequently as possible. Rupture has been known to occur from too careless and energetic palpation.

Acute congestion, present in fevers, may require anodynes and local applications to relieve the pain and sense of distension which are present. Depletion, locally with cups or leeches, or by saline purgatives, may be required, and the abdomen may be surrounded by a firm bandage to secure support. Acute swelling or acute congestion attendant upon or following miasmatic disorders is reduced as soon as the causal disease is controlled by quinine, arsenic, etc.

Passive congestion of the spleen due to cardiac disease or secondary to disturbances of the portal circulation requires remedies which control or modify the original disease. In addition to cardiac and vascular tonics, the saline purgatives must be administered cautiously, and mineral waters which relieve portal congestion are to be taken freely.

If long continued, passive congestion is attended with hypertrophy of the organ, due to overgrowth of the connective tissue. The treatment of such hypertrophy includes, first, the treatment of the cause; secondly, the use of tonics and stimulants; thirdly, salines and other cathartics to deplete the portal circulation; fourthly, the external application of stimulating liniments; and finally, the use of drugs externally which act as absorbents. The stimulating application most in favor is iodine. It may be used in the form of either the tincture or ointment. The best-known remedy, which has had a long-established reputation for its resolvent properties in this disease, is mer-

cury. Stillé advises that mercury be not administered in cases of enlargement of the spleen which have arisen in the course of hepatic disease. He refers to the papers of Twining, Crane, Vetch, Abercrombie, and others in support of this opinion, and insists that cinchona and iron should be given alone. McLean, who has had a large experience in the hospital at Netley, advises the use of an ointment of biniodide of mercury. The ointment should be rubbed into the skin of the splenic region for about ten minutes; the patient should then be exposed to the heat of a fire. This application may be made daily until the surface is irritated by the ointment, when it must be withheld until the irritation has subsided. Care must be taken to prevent salivation. Some authorities advise the use externally of cloths saturated with dilute nitro-hydrochloric acid. The compress when applied should be kept in place by a broad bandage, and should be changed every two or three days. Recently, injections of various drugs directly into the tissue of the spleen have been advised. Mosler has used, with apparently favorable results, tincture of iodine. Pepper strongly urges the hypodermic use of ergotin or of ergot in the form of the fluid extract. While benefit has been apparently derived from the use of drugs in this way, the writer believes that the hypertrophy, if reducible at all, can be reduced by other and safer means, and that the risks attendant upon injections into the spleen do not warrant their use.

Acute inflammation or abscess of the spleen is exceedingly rare, and can be recognized only with great difficulty. It is to be treated symptomatically. Pain is to be relieved by poultices or hot fomentations and by the use of anodynes. The general symptoms of such inflammation are to be treated as in inflammation of other organs. Operative methods have not been resorted to on account of the difficulty of diagnosis. Inflammation of the capsule is to be treated like localized peritonitis in any other portion of the abdomen. Blisters, poultices, and anodynes are required. Chronic inflammation of the spleen with enlargement is to be treated in accordance with the methods described under Passive Congestion.

Hæmorrhagic infarcts are presumably present when with an evident predisposing cause the spleen is found to be enlarged, painful, and the seat of tenderness. Sometimes an indurated area can be discerned on palpation. If these symptoms occur in such diseases as ulcerative endocarditis, there is not much doubt as to the nature of the process. The pain alone will demand relief, and it is to be treated as is the pain in abscess or perisplenitis.

Amyloid disease of the spleen calls for the same general principles of management as are indicated in similar disease of the liver—namely, the removal or mitigation of the cause, the institution of

proper hygienic and dietetic regimen, and the use of tonics and of remedies to lessen congestion in the portal circulation.

The treatment of carcinoma and hydatid disease is symptomatic. Tapping may be resorted to in the latter affection, and subsequently the cyst may be opened and drained.

DISEASES OF THE THYMUS AND THYROID GLANDS, AND EXOPHTHALMIC GOITRE.

By RICHARD C. NORRIS, A. M., M. D.

DISEASES OF THE THYMUS.

From a careful study of the literature of the thymus gland it will be found that diseases of this organ are very rare. This is not surprising when it is remembered that its functional activity is confined to the first few years of life, fatty degeneration and atrophy occurring about the tenth or fourteenth year. Hypertrophy of the thymus, and the compression of the trachea resulting therefrom, have been the cause of sudden death in new-born infants. An autopsy upon a case under my observation showed the trachea to be almost completely occluded. Jacobi [1] in an extensive study of diseases of the thymus records the occurrence of hypertrophy, hæmorrhages, cysts, inflammation, tuberculosis, syphilis, diphtheria, and persistence of the gland. Malignant diseases have occasionally been found. The character of these affections is such as to baffle efforts at diagnosis, and opportunity for treatment is not likely to arise.

The gland has been removed from animals with no apparent ill effect, and in cases in which its hypertrophy will certainly produce fatal asphyxia its extirpation would seem justifiable. Syphilitic enlargement calls for inunctions of blue ointment over the gland, and the administration internally of calomel in fractional doses guarded with chalk. Cysts will require puncture and aspiration.

DISEASES OF THE THYROID.

The disease of this organ of greatest clinical importance, and the one most commonly requiring treatment, is goitre. Hyperæmia, acute inflammation, and suppuration independent of any previous enlargement, sometimes occur. Other pathological processes occasionally met with are syphilis, tuberculosis, and malignant disease, either carcinoma or sarcoma.

[1] "Contributions to the Anatomy and Pathology of the Thymus Gland," *Trans. Assoc. Amer. Phys.*, 1888.

Hyperæmia of the thyroid may be secondary to or coincident with pregnancy and menstruation, affections of the bronchi or lungs, valvular diseases of the heart, acute rheumatic or malarial fever, and arthritis. Originating in this way, the hyperæmia is usually not very great, and requires no special treatment except in rare instances: the sudden compression of the trachea and veins of the neck by an acute enlargement may demand phlebotomy or tracheotomy to prevent a rapidly fatal asphyxia. When the physiological hyperæmia and enlargement of the thyroid body in pregnancy becomes exaggerated to such a degree as to produce alarming symptoms, the advisability of inducing premature labor should be considered.

Acute idiopathic thyroiditis is certainly of rare occurrence. Should it develop as the result of injury inflicted upon the gland, it will be necessary to resort to the ordinary treatment of acute glandular inflammation, including incision and drainage in the event of suppuration.

Syphilis and tuberculosis of the thyroid are very rare. Their treatment combines active measures directed to the constitutional affection, and the same local and surgical treatment as for goitre, when suffocative symptoms indicate the necessity for such a procedure.

Carcinoma and *sarcoma* of the thyroid gland are comparatively rare. Their rapid growth and involvement of the entire gland, and the speedy generalization of the disease, render treatment by any means practically useless. Surgeons are now almost unanimous that with but few exceptions surgical interference beyond tracheotomy is not justifiable. In Kocher's[1] statistics 25 cases were subjected to surgical treatment, with a mortality of 17 per cent.

Goitre.

It will be convenient to discuss the treatment of goitre as applicable to the following varieties: fibrous, follicular, cystic, and vascular. Exophthalmic goitre, being distinctly different clinically, will receive separate consideration. The treatment of goitre may, in general, be said to comprise the use of drugs, administered internally, externally, and by injection; electricity; or one of the various surgical procedures. The choice of treatment should be determined by the size, form, situation, and variety of the tumor. When the latter by its size or by its situation, as in substernal goitre, produces pressure-symptoms, such as suffocative dyspnœa, dysphagia, or tracheal stridor, it is certain that a plan of treatment requiring for its completion days or weeks is not to be thought of, and, as will be pointed out later, one variety of goitre is often amenable to a plan of treatment which would prove utterly useless in another variety. It should also be remembered that

[1] "Bericht über weitere 250 Kropfextirpationen," *Correspondenzbl. f. Schweizer Aerzte*, Basle, 1889, xix., L. 33.

the different varieties shade into one another, and in reaching a diagnosis of the variety the consistence of the enlargement will be found to vary according to the pathological processes which have been going on. In fibrous goitre the enlargement will be hard, resisting, and knotty, particularly at those portions of the gland where the overgrowth of interstitial tissue is pronounced and vascularity diminished. The follicular variety, in its early stages of development at least, will be soft and yielding. Cystic goitre is soft, and presents in certain situations distinct fluctuation, or the latter may be detected throughout the entire tumor when the follicles and their cystic contents finally intercommunicate.

Sometimes, when the contents of the gland are gelatinous, it is comparatively firm and of doughy consistence, its vascularity disappearing under the pressure of the increased distension of the follicles by their accumulating colloid contents. When the enlargement and hyperplasia of the blood-vessels, either arteries or veins, constitute the special feature of the tumor, forming the vascular variety, it will be compressible, soft, and elastic, and there may be pulsation and a distinct bruit, resembling that of aneurism.

Prophylactic Treatment.—Change of climate to a region where goitre is not endemic, and strict attention to diet and hygienic surroundings, will do much to prevent the development of this disease, and effect a cure in those already affected, particularly when the tumor is of small size. When this change of climate is impossible, the drinking-water should be investigated, and freed as far as possible from the earthy salts by boiling, by distillation, or by precipitation of these ingredients. The temporary enlargement of the thyroid during pregnancy and the menstrual flow has long been observed, and it is claimed that when there exists this tendency to the development of goitre in a pregnant woman, nursing the child had best be discarded, since it has sometimes appeared to bear a causal relation to the development of goitre. When hypertrophy of the gland exists, influences likely to check the menstrual flow should also be avoided.

Internal Treatment.—Of the various methods of treatment by medicines, constitutionally or locally, the one most commonly employed is the use of iodine or mercury in one form or another. Though occasionally successful, in the majority of cases failure to effect complete cure has more often followed their use, due unquestionably, in many instances, to the fact that the variety of the tumor has not been recognized. It is true that precise diagnosis of the variety is often difficult and sometimes impossible, as there is so frequently a combination of pathological processes, yet the preponderance of one or the other will often be sufficient to make clear the proper plan of treatment. In all varieties of goitre, iodine and its various preparations

have been largely used internally since first recommended by Dr. Coindet of Geneva, and the testimony of its curative value is strong. On the other hand, however, it has signally failed very many times, and the recorded cases of both successes and failures indicate that administered internally it is of value only in the fibrous and follicular varieties and in the early stages of the disease. The compound solution of iodine, iodide of potassium, and iodide of iron are eligible preparations, varying the dose, interchanging them, or intermitting their use as the stomach and general condition of the patient (iodism) may indicate.

Agnew[1] thus formulates the method of their administration: "If the patient is in all other respects in good health, and especially is somewhat fleshy or given to obesity, the compound solution of iodine should of preference be selected. At first the dose should be small, in order to test the tolerance of the stomach, not exceeding 5 or 6 drops three times a day, taken in some sweetened water, orange syrup, or curaçoa, and always about one hour after meals. Every two or three days the dose may be increased one or two drops until 18 or 20 are taken, beyond which it is not desirable to go." Should iodism occur, or after two or three months' continuous treatment should no impression be made on the disease, he advises the substitution of the iodide of potassium, 5 to 20 grains three times a day, dissolved in water and syrup and well diluted. When anæmia is associated with the disease, iodide of iron and cod-liver oil may be alternated with the remedies already directed.

Local Treatment.—In conjunction with the constitutional treatment just described in these varieties of goitre, considerable improvement can be expected from local applications, either in the form of ointments or by hypodermic injections. For the former, iodoform and the iodide or red oxide of mercury will be found useful. Iodoform may be prescribed in the strength of 1½ drachms to 1 ounce of lanolin, petrolatum, or benzoated lard, to be rubbed into the gland morning and evening, preferably before an open fire, and lint spread with the ointment should be kept in contact with the swelling. Should the preparations of mercury be selected, the following formulæ will be found of service:

℞. Ung. hydrarg. iodid. rub.,
Petrolati, āā. ℥ss.—M.

A portion of this ointment about the size of a walnut should be rubbed in daily or every other day, according to the degree of irritation produced:

[1] Pepper's *System of Medicine*, vol. iii. p. 981, Phila., 1885.

℞. Pulv. hydrarg. oxid. rub., ʒij;
Lanolini, ʒj.—M.

Brown [1] recommends this ointment very highly, claiming that it rarely irritates the skin except in warm weather, when its strength should be reduced. He insists upon having the drug in very fine powder before its incorporation into the lanolin, and advises the strength to be increased to saturation, as it is found to be well borne. Frequently the efficacy of an ointment can be increased by the application of pressure to the gland, but should the skin begin to resent it by giving evidence of irritation, it should be discontinued.

In a large proportion of cases this local treatment will accomplish little more than slight reduction in the size of the tumor, and injections may at this time, or even earlier, be resorted to with more hope of success; yet this procedure will also frequently be more or less of a failure in effecting complete cure. It is more apt to be serviceable in follicular and cystic than in fibrous enlargement. The drugs employed for this purpose are numerous. Iodine, ergotin, iodoform, alcohol, osmic acid, perchloride of iron, and solutions of arsenic, have all been used with asserted success, iodine occupying the foremost rank in follicular and fibrous goitre since first recommended by Lück in 1867. The syringe and the skin over the point of puncture should be antiseptically clean, and, the needle being thrust in half an inch to an inch, from 8 to 30 drops of the tincture are slowly injected, after which the opening is to be closed by adhesive plaster or similar dressing. The injections should usually be made twice a week, and the quantity used is that given above, but the frequency and amount are determined for each individual case by the degree of reaction. After one or two injections, a different point of entrance being selected each time, a syringeful has been used without causing complications. A single injection in cases of small tumors has been sufficient. Following the operation, pain, varying in severity, is usually to be expected in the teeth, ear, eye, and maxillary articulation on the side on which the injection has been made; and if the latter is low down some discomfort in the chest may be present. Elevation of temperature and signs of aggressive inflammation contraindicate a repetition of the injection until they have completely subsided.

Ergotin by injection has given good results. It has been used with success by Pepper, DaCosta, and others. The solution employed is made by dissolving 96 grains of ergotin in 1 ounce of distilled water, of which 6 to 10 minims are injected weekly. The fluid extract of ergot may be similarly used, the dose being from 10 to 20 drops. Mosetig v. Moorhof claims that iodoform has the advan-

[1] *North American Practitioner*, Aug., 1890.

tage over other drugs for hypodermic injection that inflammatory complications never occur. He recommends the following solutions: Iodoform 1 part, ether 5 parts, olive oil 9 parts; or iodoform 1, ether and olive oil, each 7 parts. He injected from 15 to 30 drops of this mixture five to ten times, at intervals of three or four days, in 79 cases, and invariably noticed a decrease in the size of the neck of from one to two inches. In no instance did suppuration occur.

While the treatment of goitre by parenchymatous injection is often measurably successful, it is attended by many complications, such as hæmorrhage or embolism, violent inflammation, suppuration, and septic poisoning, and is, therefore, by no means devoid of danger. Death has occurred in several reported cases after many weeks of prolonged suppuration, or more speedily from obstruction to respiration occasioned by rapid swelling of the gland. Doubtless there are many unrecorded cases of this unfortunate result. Its relative value as a method of treating the varieties of goitre to which it is applicable is certainly less since the results of the recent surgery of the thyroid body have been made known.

Although constitutional treatment, of the character outlined when discussing fibrous and follicular goitre, has been resorted to very frequently in the treatment of cystic bronchocele, it has invariably been a signal failure. The only possible benefit to be derived from drugs is by their local application in the form of injection. When the cysts are multiple and thick-walled, the process is tedious, repeated injections being required, or, as recommended by Agnew, it may be necessary to break up the separating walls of the cyst by a plunger, so as to favor the diffusion of the drug used. In a single cyst with thin walls puncture followed by injection is usually curative. The perchloride of iron is preferable to iodine, being less dangerous, and the method to be employed is that of Morell Mackenzie. The cyst is tapped at its most dependent part with a trochar, the canula of which corresponds in size to a No. 8 or 9 English catheter. After the contents partially escape, 1 to 2 drachms of a solution of perchloride of iron (2 drachms to distilled water 1 ounce) is injected, and allowed to remain for three days, the canula having been corked and kept in position by a tape passed around the neck. At the end of this time the plug is removed, and if suppuration has not occurred the injection is repeated. When suppuration occurs the plug is removed, and the cavity is treated as a chronic abscess by washing with antiseptic solutions and applying poultices to the neck. In 193 cases so treated there were 2 deaths, the goitres in the fatal cases being partly fibrous.

In the vascular variety of goitre, or when the goitre is rich in its blood-supply, ergot administered internally in 10- to 30-drop doses of the fluid extract will be useful. Iodine is practically worthless.

Locally, 10 to 30 drops of the fluid extract of ergot may be injected, or ergotin may be used as has been directed for the fibrous and follicular varieties. Deep injections, at intervals of four or five days, of 4 or 5 drops of carbolic acid, liquefied by the smallest possible quantity of glycerin, are also worthy of trial.

Electrical Treatment of Goitre.—The successful treatment of goitre by electricity is confined to the use of electrolysis by galvano-puncture, and possibly the employment of the galvanic current in conjunction with drugs to secure a cataphoric action.

That electrolysis is curative in some varieties of goitre is unquestionable, and it is equally true that it sometimes utterly fails. It will be most useful when employed for goitres of comparatively small size —*i. e.* in the early stage of their development, when they are soft and of the follicular variety, as is so often the case. Purely fibrous goitres are also frequently benefited, if not cured. Even the vascular variety has improved, under its action, although it usually fails, as it does in cystic goitre, and in both it may prove harmful. Successful treatment of goitre by this means has been frequently reported, notably by Amory, Baird, Campbell, Chvostek, Duncan, Gröh, Ingalls, Lloyd, and others. Duncan[1] completely cured 6 of 14 cases, the others being more or less benefited. Ingalls reports[2] success with electrolysis after failure with aspiration and injection of carbolic acid. Lloyd cured 2 favorable cases.

In the application of electrolysis the following points should be borne in mind:[3] The negative needle or needles, properly cleaned and well insulated to protect the skin, should be introduced into the tumor about one-third of an inch, care being taken to avoid blood-vessels. The positive pole is applied to the nape of the neck by means of a large flat sponge electrode. The strength of the current should be as great as the patient can bear, the average being from 14 to 20 milliampères, which should always be measured accurately by a milliampèremeter, and a water rheostat should be used to avoid shocks. The length of each sitting should be about twenty minutes, and the application repeated at intervals of about two weeks. Inflammation in the gland will sometimes follow, although it is usually mild and transient, suppuration being of very rare occurrence. Permanent results sometimes are not manifest until the treatment has been persisted in for some time, and once begun the decrease in the swelling progresses after the applications have been discontinued. As the gland is not completely destroyed, the possibility of the development of myxœdema is reduced to a minimum.

At a meeting of the Richmond Academy of Medicine and Surgery,

[1] *British Med. Journ.*, Nov. 3, 1888. [2] *Journ. Am. Med. Assoc.*, xiv., 1890.
[3] See paper by Dr. James Hendrie Lloyd, *Trans. Coll. Physicians*, Phila., 1890.

July 6, 1891,[1] Hunter McGuire described the cataphoric treatment of goitre by means of a cup-shaped electrode, in which is placed some absorbent cotton first dipped in water and squeezed as dry as possible; and on this cotton 10 or 15 drops of the tincture of iodine is poured. The electrode, thus prepared, is placed on the most prominent part of the goitre, the negative pole on the back of the neck. A galvanic current of 6 or 8 milliampères is passed daily for ten minutes over a period of several weeks. Three cases of chronic goitre treated in this way gave the same result: the hypertrophy diminished, rapidly at first, then more slowly, and finally became stationary. In 4 cases of recent hypertrophy of the thyroid in young women the enlargement rapidly disappeared. What proportion of the good results from this plan of treatment is due to one or the other of these agents it is impossible to say. The varieties of goitre most likely to be benefited are those which are more or less amenable to the injection of iodine and the employment of electrolysis—namely, the follicular, fibrous, and possibly the vascular varieties.

Surgical Treatment.—While a discussion of the surgical treatment of goitre is not altogether in place in a volume of the character of this work, it may not be amiss, in a general way, to outline the resources of surgical intervention and its results, in view of the fact that in recent years the most noteworthy advance in the treatment of goitre is certainly the resort to surgical procedures. Among those who have done most to advance the surgery of the thyroid gland are Kocher, Keser, Billroth, Socin, Niehaus, Mikulicz, Trzebicky, Porta, Julliard, Müller, Garrè, and Berry. To the work and literary contributions of the last the writer acknowledges especial indebtedness for many facts.

When, in spite of thorough medical and electrical treatment, hypertrophy of the thyroid gland continues until the life of the patient is threatened by the appearance of pressure-symptoms—an event which fortunately is rare—or when, before this occurs, application is made to surgical art for relief, the procedures to be considered are the introduction of a seton, incision and drainage, ligature of the thyroid arteries, division of the isthmus or middle lobe, extirpation of a portion of the gland, and enucleation.

Introduction of a Seton.—This is an antiquated method of treatment and is no longer employed. Its great dangers of hæmorrhage and long-continued suppuration have finally made it obsolete, and it is only mentioned to be condemned.

Incision and Drainage.—For cases wholly or in large part cystic, when enucleation is for any reason contraindicated—this operation may be performed. The cyst should be exposed by a careful dissection and

[1] Quoted in *Cincinnati Lancet Clinic*, Aug. 15, 1891, from *Virg. Med. Monthly.*

incised, the cyst-wall stitched to the skin, and the cavity irrigated with an antiseptic solution. A drainage-tube and iodoform gauze packing are introduced into the cavity and an antiseptic dressing applied. Dr. John B. Deaver[1] believes that this operation offers the best treatment for such cases when thyroidectomy is contraindicated.

Ligature of the Thyroid Arteries.—This method of treatment, first suggested by Wölfler of Gratz, aims to cause atrophy and gradual disappearance of the tumor by ligature of the nutrient arteries. The difficult character of the operation, the danger of injuring the sympathetic nerve, and the usual establishment of an extensive collateral circulation, have made it a question to most surgeons whether much is to be gained by this method of treatment. It is not suitable for cystic and fibrous goitres, and should be reserved for cases of early follicular or vascular tumors. It can, perhaps, be done with advantage in conjunction with division of the isthmus when for any special reason the latter is employed. In 7 cases of ligature of the afferent arteries in Billroth's clinic,[2] in 3 enucleation had to be performed within three years; 4 were permanently cured. Rydygier[3] reports 16 cases, in 1 of which there was only slight diminution in the size of the tumor; in another one lobe contained a cyst which subsequently required enucleation. Whether the arteries on both sides or on one side only, or the lower blood-vessels alone, or the afferent vessels of the large portion of the goitre, are ligated, as have severally been recommended, the operation is now generally thought to be of very restricted usefulness.

Division of the Isthmus or Middle Lobe.—When the tumor is very large, involving the entire gland, division of the isthmus will frequently relieve the dyspnœa mechanically, the two halves of the tumor being thus separated. Mr. Berry[4] believes that it more often relieves the respiratory difficulty by draining the gland of its colloid secretion, and that while the relief afforded may be permanent, the goitre frequently returns when the wound has healed, and the secretion is again pent up in the gland. It should be remembered also that urgent dyspnœa has sometimes not been relieved sufficiently quickly, and in some cases tracheotomy or removal of a large portion of the gland has been necessary.

Extirpation of a Portion of the Gland.—The immediate danger of injury to the recurrent laryngeal nerve and the remote danger of myxœdema or tetany have rendered the operation of complete removal of the thyroid body generally unjustifiable. Partial extirpation, however, has been attended with such success as to give it a definite

[1] *American Lancet*, July, 1891. [2] *Brit. Med. Journ.*, May 31, 1890.

[3] *Wien. med. Wochensch.*, 1888, xxxviii., 1683; *Centralb. f. Chir.*, Leipzig, 1889, xvi. 241.

[4] *British Med. Journ.*, June 20, 1891.

and meritorious position in the surgery of the thyroid. It includes the removal of one lobe; resection of the chief part of one or both lateral lobes, avoiding the recurrent laryngeal nerves by leaving behind in relation to them sufficient gland-tissue to carry on the functions of the gland; and resection of the intervening portion of the isthmus between two ligatures. When the goitre is unilateral, the removal of the enlarged lobe is indicated. When there is diffuse hypertrophy or numerous small nodules with no normal gland-tissue, resection is to be performed. Resection of the isthmus is rarely indicated, as it does not usually remove enough tissue to relieve the dyspnœa permanently, and is not devoid of danger.

Enucleation.—This operation is applicable to cystic and fibroid tumors which are surrounded by a capsule and more or less healthy gland-tissue, thus permitting the removal of the solid or cystic tumor from the interior of the gland, the surrounding glandular tissue being left intact. Keser[1] and Kocher,[2] who have contributed largely to our knowledge of the value of this operation, discuss its advantages and limitations. Keser states that the operation can be done rapidly, usually without great hæmorrhage; that the recurrent laryngeal nerves are never injured; and that cachexia strumipriva or tetany is never a sequel. When the gland is the seat of diffuse hypertrophy or disseminated nodules or malignant disease, he considers enucleation contraindicated. Kocher favors the operation in many cases, and his greatest objection to it is that recurrence is more apt to occur than after partial extirpation. He considers enucleation applicable to single large cysts or large solid tumors loosely imbedded in healthy gland-tissue. Of the recorded cases of enucleation in the hands of the best operators, I find the death-rate somewhat less than 1 per cent.

Cachexia Strumipriva.

As to the occurrence of cachexia strumipriva as a remote result of thyroidectomy, I cannot do better than quote the conclusions of Berry,[3] based upon an extensive statistical study. If the gland be completely removed, there is very great risk that this sequel will supervene, although it is not absolutely certain that it will do so in all cases. The risk, however, is sufficiently great to warrant us in laying down the rule that complete extirpation of a goitrous thyroid gland should never be performed. It has unfortunately followed partial extirpation in a few cases, but the cases in which this has happened are exceedingly few in number, and in them the symptoms of the disease have

[1] *L'Enucleation ou Extirpation intraglandulaire du Goître parenchymateux*, Paris, 1887.

[2] "Bericht über weitere 250 Kropfextirpationen," *Correspondenzbl. f. Schw. Aerzte*, Basle, 1889, xix. L. 33.

[3] *Brit. Med. Journ.*, June 27, 1891.

usually been slight and temporary. The treatment of this sequel is unfortunately very unsatisfactory. The patient should be kept warm, and, if possible, sent to a warm climate. Pilocarpine, jaborandi, and nitro-glycerin have been recommended, as in myxœdema. The transplantation of thyroid tissue into the abdominal cavity of the patient has been suggested and practised, and Mr. Horsely[1] believes that the beneficial results of the operation have been established. It has, however, been done but seldom, and then with only temporary improvement, so that future experiments must decide the true value of the procedure.

EXOPHTHALMIC GOITRE (GRAVES' DISEASE; BASEDOW'S DISEASE).

THE plans of treatment advocated and the numerous drugs which have from time to time been reported as successful in the treatment of this mysterious disease simply emphasize our ignorance of its precise etiology and pathology, and therefore render the treatment in greatest measure symptomatic. The theory of nervous origin is most generally believed in, and the lesion thought to be most probably in the medulla and upper cervical portion of the cord—a conclusion which seems warranted by the involvement so frequently in this disease of other centres known to be situated there—namely, the cardio-inhibitory, accelerator, vaso-motor, vomiting, and glycogenic centres. In the absence, therefore, of accurate knowledge as to etiology and pathology upon which to lay the foundations of an exact and rational therapy, it will be convenient to direct our treatment to the important symptoms and complications which arise in this disease. It should be remembered that there is no specific or special mode of treatment applicable to all cases.

The principal element in the successful management of exophthalmic goitre is the removal of the patient from the environment in which the disease has had its origin to surroundings agreeable and most likely to secure rest of mind and body. Occasional mental diversion is desirable, particularly when despondency is pronounced. When possible, an inland region of not very great altitude should be selected. The well-known ill effect of the atmosphere of elevated situations upon an exhausted and irritable nervous system indicates very clearly that a mountainous district of great altitude is not to be selected as the abode for sufferers from this disease. Curtin,[2] who has made a careful clinical study of the disease, and has observed a large number of cases over a period of years, concludes that a mountain residence is unfavorable for developed cases, and even for persons who have only a hereditary tendency in this

[1] *Brit. Med. Journ.*, 1890, ii. 201. [2] *Trans. Amer. Climat. Soc.*, Sept., 1888.

direction. Dampness and exposure to cold should be scrupulously avoided, as so many cases give evidence of past or present affections of the respiratory tract, such as chronic rhinitis, pharyngitis, or bronchitis; and when these exist appropriate treatment will be followed by marked improvement in the general condition.[1]

Patients suffering from this disease frequently do badly by the sea, yet when sea-bathing is known to be agreeable, and not too invigorating, to the patient, it can be moderately indulged in with strikingly good effect. Considerable success has been attained in many cases by hydropathic treatment, as recommended by the French physicians. The hygienic surroundings should be most carefully attended to—regular rest, exercise with salt sponge-baths, and frictions. The diet should be such as to improve the general nutrition, and tobacco and alcoholic and malt liquors must be discarded. This complete change in the patient's surroundings, and careful attention to the details of his daily life, are absolutely essential to the success of any special form of treatment.

Milk in generous quantity, cod-liver oil, arsenic, quinine, iron, and other tonics are to be employed when specially indicated. Coexisting disorders of any nature should be corrected. This is particularly true of anæmia, which is rarely absent, and when present to a marked degree is productive of the mental depression, hysterical manifestations, neuralgic pains, vertigo, etc. which are so frequently noted in this disease. Preparations of iron should be administered continuously over a long period of time. Flint[2] records a case in which recovery took place, the patient having taken 2 grains of reduced iron thrice daily for three years. As the greater proportion of cases of Graves' disease is found in women between puberty and middle age, and since uterine disorders so frequently coexist, the latter should always be looked for and if present appropriately treated.

Digestive derangements are very prone to occur, and should always receive first attention, as without their correction other treatment will avail but little. A diet restricted to milk, broths, farinaceous foodstuffs, etc. may be required.

Rest in bed is advisable when the patient is very weak or nervous, and troublesome insomnia requires narcotics. It is best to avoid opium as far as possible, the bromides being chosen in their place, but it may be necessary to employ the former.

The cardinal symptoms of exophthalmic goitre are cardiac palpitation and pulsations in the larger blood-vessels, goitre, exophthalmos, and vibratory tremor. It is to the amelioration of these that treatment will be directed. The patient should be told that the disease is not

[1] Fiske-Bryson, *N. Y. Med. Journ.*, Dec., 1889.

[2] Pepper's *System of Medicine*, vol. iii. p. 766.

directly dangerous to life; that, while it tends to long continuance, it not infrequently improves to a very marked degree; and that sometimes it disappears altogether.

Treatment directed to the Heart and Circulation.—Of the cardinal symptoms of Graves' disease, cardiac palpitation and pulsation in the larger blood-vessels are the most constant, and usually the first to develop. They are also the symptoms which usually cause most discomfort to the patient, disturbing as they do other functions of the body, and for which relief is sought. When the disease is of long standing, inducing dilatation, or when from other causes there exist organic changes in the heart, treatment should be directed to these changes, as under other circumstances. The rapid and tumultuous heart-action is a rational indication for the employment of drugs known to lessen the frequency and force of the cardiac pulsations. For the former purpose digitalis or strophanthus is to be used. All writers agree that digitalis is a useful remedy in this disease. Recently the reports of the use of strophanthus are numerous and satisfactory[1] in improving the pulse-rate and rhythm of the cardiac contractions in exophthalmic goitre. Unlike digitalis, it does not much contract the calibre of the arterioles, and thus increase the work of the heart, yet, like digitalis, it markedly lengthens the intervals between the contractions. In a case under my observation it afforded great relief after digitalis had been faithfully tried with only slight benefit. The tincture should be given three times daily after meals, the initial dose being from 8 to 10 drops, which may be increased, if necessary to reduce the frequency of the pulse, to even 25 drops.

In some cases the sedative action of aconite, veratrum, or gelsemium may be resorted to with more benefit than either digitalis or strophanthus. Flint speaks highly of aconite, and says[2] it has proved more satisfactory than digitalis in his experience. When the muscular action of the heart is vigorous and powerful, particularly when associated with hypertrophy, which is not infrequent, their depressant action would seem desirable. Under such circumstances veratrum viride will be found of service, 1 drop of the fluid extract given every three hours, and increased or diminished according to the effect upon the pulse and cardiac contractions. Belladonna and its alkaloid, atropine, have been largely used, and in some cases have been more beneficial than the drugs just mentioned. Ramsay,[3] who has studied this disease exhaustively, concludes that of all drug treatment probably that from which the best results are most frequently obtained is the use of belladonna or atropine, and that ergot, the bromides, and the iodides, in spite

[1] *N. Y. Med. Journ.*, Aug. 4, 1888, and Nov. 8, 1890; *Journ. Am. Med. Assoc.*, Sept. 1, 1888, and Nov. 3, 1888.

[2] *Loc. cit.*

[3] *Glasgow Med. Journ.*, Aug., and Sept., 1891.

of all that has been written in their favor, rarely fail to give disappointing results.

Since first recommended by Benedikt[1] in 1865, electricity has been used with undoubted success. Many chronic cases have been benefited by its use after drugs have proven an absolute failure. It is said to cause undue excitement in acute forms of the disease.[2] Nothnagel[3] considers persistent electrical treatment, combined with a hydrotherapeutic course, the most efficient treatment of the disease. Galvanism is superior to faradism for this purpose. A current of 2 to 3 milliampères is sufficient,[4] the applications being made three times a day, each lasting six minutes. The anode should be placed on the nape of the neck, the centre of its lower border corresponding to the seventh cervical spinous process. The cathode should be moved up and down the side of the neck from the mastoid process along the course of the great nerves. Bartholow[5] gives the following directions: "An electrode—the anode—is placed in the angle behind the jaw, and the cathode on the epigastrium, and a stabile current is allowed to flow for three to five minutes. The cervical spine should also be galvanized. It may be included in a circuit by placing the anode over the vertebræ in turn, whilst the cathode rests on the epigastrium. Stabile may be varied by labile applications." After application of the current by either of the above plans, the frequency and force of the heart-beat are reduced temporarily, prolongation of the diastole being most marked; and as the treatment is continued these effects become permanent. Charcot advises the application of the faradic current to the eyelids, the goitre, and the cardiac region, in addition to the current applied to the neck. In a case of pronounced exophthalmic goitre Hunter McGuire[6] obtained by cataphoric treatment with iodine rapid diminution of the enlarged thyroid gland, and a decided amelioration of the other symptoms.

Although the majority of cases of Graves' disease continue for several years, and are rarely directly dangerous to life, not infrequently the attacks of palpitation are of such violent character as to jeopardize life and call for prompt and active treatment. When the patient's general condition will permit it, venesection may be resorted to, but usually the attack will be more safely combated by an ice-bag to the præcordial region or over the neck, as recommended by Nothnagel; the free use of cardiac stimulants, as ether, Hoffman's anodyne, digitalis, strophanthus, nitrite of amyl by inhalation, and morphine and atropine hypodermically. The violence of the heart's

[1] *Aerzt. Zeitschr. f. Prakt. Heilk.*, 1865.
[2] Cheadle, *Brit. Med. Journ.*, Jan., 1890.
[3] *Practitioner*, March, 1890.
[4] Cardew, *Lancet*, 1891, No. 3540.
[5] *Medical Electricity*, Phila., 1881.
[6] *Loc. cit.*

action can also be greatly diminished by the application of a sufficiently strong galvanic current to the pneumogastric nerve.

Treatment directed to the Enlarged Thyroid.—Usually the enlargement of the thyroid gland requires no special treatment. The measures recommended above will in most cases cause a diminution in the size of, and lessen the pulsations in, the gland, *pari passu* with the improvement in the cardiac symptoms. In addition to these, however, a weak continuous current applied to the gland with a large plate electrode may be resorted to. Lister's cold coil has benefited some cases, and DaCosta[1] has recommended the daily application of ice. Recently, MacNulty[2] has employed a Martin's bandage around the throat, to be worn during the day and taken off during the night.

Belladonna collodion has been found of service for the violent pulsations in the gland. Iodine, so commonly used in ordinary bronchocele, should not be employed in exophthalmic goitre. Practically, the same may be said of ergot, although it has sometimes been of apparent service, administered both internally and by hypodermic injection, the dose and method being the same as described for ordinary bronchocele. Sulphuric acid has apparently been of service in some cases.[3] Without further mention of the various drugs extolled from time to time, it may be remarked that the tranquillizing effect of a placebo has often been followed by marked improvement, and no doubt the beneficial results claimed for various drugs can in great measure be thus explained. Tracheal obstruction by pressure of the enlarged gland is very rare in exophthalmic goitre. Its occurrence should be promptly met by the inhalation of chloroform, followed if necessary by tracheotomy, incision of the capsule of the tumor, or division of the isthmus, and even partial extirpation.

Treatment directed to the Exophthalmos.—Whether the protrusion of the eyeball be due to turgescence of the blood-vessels of the orbit and an increase or swelling of the orbital fat, or to contraction of a layer of unstriped muscular fibre crossing the spheno-maxillary fissure described by Müller, there is as yet no means of directly lessening to a great extent this distressingly prominent symptom. This is particularly unfortunate, since the prominence of the eyeball is so frequently a source of mortification to the patient, contributing to despondency by its being an ever-present deformity. A compress and bandage worn during sleep have been of service, and in conjunction with this a mild faradic current may be used daily. As a matter of experience DaCosta[4] has found it very suitable to give an occasional saline purge. It is always followed by better vision, and is all the more

[1] *College and Clinical Record*, Oct. 15, 1880.
[2] *Rev. international de Bibl. médicale*, No. 2, 1891.
[3] *Med. News*, Nov. 3, 1888.
[4] *Loc. cit.*

indicated when cerebral symptoms exist. By far the most important treatment directed to the eyes is the prevention of an irritative conjunctivitis and consequent corneal ulceration, which not infrequently occurs as the result of the insufficient covering and excessive dryness of the protruding eyeballs. As far as possible, reading, writing, or other efforts in any way productive of eye-strain should be avoided. If necessary, a simple emollient, as lanolin or vaseline, should be applied to the lids and the eyes covered with a bandage. The smarting and burning can often be relieved by cold compresses. At the first sign of inflammation careful treatment should be instituted to prevent ulceration, and in the event of the latter occurring confinement to bed will be necessary to follow out accurate antiseptic management. When the exophthalmos is so great as to threaten grave inflammatory changes in the eyeball, tarsorrhaphy, as recommended by Von Graefe, becomes a desirable operation to close the lids partially and lessen the deformity.

DISEASES OF THE MOUTH AND SALIVARY GLANDS, INCLUDING MUMPS.

By A. D. BLACKADER, M.D.

At the outset of any remarks on the treatment of diseases of the mouth it seems advisable to make some reference to the connection that by many authors is considered to exist between ailments in the mouth and pathological conditions in the lower portions of the alimentary canal—an opinion that has, possibly, arisen from the furred condition the tongue assumes in many affections of the stomach, and from the occasional appearance of aphthous spots with coincident dyspepsia. That the eructation or vomiting of acrid and fermenting matter may produce some irritation of the oral mucous membrane, and that prolonged retention of fæcal matter in the bowels may injuriously affect the secretions of the mouth, will probably be admitted by most. "But it is a mistake," quoting the words of a recent writer,[1] "to ascribe, as is so commonly done, the greater number of inflammatory conditions of the mouth to an existing gastro-enteric perversion. And although bad feeding and improper hygienic surroundings are responsible for many affections of the mouth, as well as of the stomach and intestines, it is not by any previous dyspepsia that the former are caused, but rather they are as much primary in origin as are the latter." In many cases the sequence appears to be the other way, for the swallowing of large quantities of saliva and mucus teeming with pathogenic micro-organisms must interfere seriously with the action of the gastric juice. Distinct recognition in the matter of treatment must therefore be accorded to affections of the mouth, apart from any coincident troubles of the stomach. In at least all the more severe inflammatory affections of the mouth local applications are demanded, and to these, if suitable, the ailments quickly yield; but treatment directed only to the stomach cannot be considered as filling the more important indications.

In securing this local action drugs may be used either as mouth-washes or sprays, or may be applied directly to the part by means of a camel's-hair brush. Mouth-washes for infants may be used either with

[1] W. W. Allchin, M. D., art. "Diseases of the Mouth," in Keating's *Cyclopædia of the Dis. of Children*, vol. iv.

a swab of absorbent cotton on the end of a small piece of wood suitable as a handle, or may sometimes be thrown into the cavity of the mouth with a syringe, the head being sufficiently inclined forward to allow the escape of the fluid from the mouth. In the case of adults mouth-washes are kept in contact with the walls of the oral cavity for the longest possible time by slightly dilating the cheeks. In ordering the wash not only must the ingredients be carefully selected, but the strength of the solution must be adjusted to each case.

With a few drugs not only do we secure a local action by their use in these ways, but also a secondary action by the elimination of the drug through the salivary glands. Notably is this the case with potassium chlorate, which, when taken internally, appears in the saliva in five or ten minutes, and continues to be secreted for some hours. In this way we obtain a secondary topical effect, much to be desired because less irritating and more continuous. It should be always borne in mind, however, that in large doses it affects the secretion of urine unfavorably. The quantity administered during the whole period of the twenty-four hours to an adult should never exceed 1 drachm or 1½ drachms, and to a child of three years 20 or 30 grains. It is best given in small doses, repeated every two or three hours, and should be always largely diluted to lessen its irritating action on distant organs. Whenever it is administered in full amounts, Forchheimer[1] recommends that the physician should always impress on the attendant the necessity of watching, lest any diminution or cessation occur in the secretion of urine. Coincidently, a state of drowsiness is occasionally noted. Both are to be regarded as important danger-signals. On their appearance the exhibition of the drug must be at least temporarily discontinued.

In making local applications to the mouth it is very necessary that gentleness should be used. "Roughness should be avoided in treating sore mouths; not to mention the pain that is given, we do absolute harm by using mechanical violence. In but one form of stomatitis is it necessary to remove anything. In all the rest applications made by the gentlest means will give the best results." Especially is this the case if we are dealing with infectious processes, where any undue irritation of the mucous membrane renders an extension of the disease more liable.

Absolute cleanliness of the mouth at all times is demanded as a simple matter of hygiene. Much more is it necessary when through disease the secretions of the mouth are altered, or when through debility or pain the muscles of the tongue and mouth are prevented from using their wonted activity. In all inflammatory states of the system it is desirable to direct the attendant to have the patient's mouth

[1] *Archives of Pediatrics*, Sept., 1888.

washed thoroughly at least twice a day, better still, after each time of feeding, with some slightly alkaline and antiseptic wash. A solution of bicarbonate of sodium (5 grains to 1 ounce), with 2 or 3 drops of carbolic acid or 15 or 20 of listerine, makes a suitable mouth-wash; or 10 or 15 drops of Condy's fluid in a half tumbler of water, or one of Seiler's antiseptic and alkaline tablets, dissolved in 2 ounces of water, can also be conveniently used.

In infants gentle washing of the mouth with a small pledget of absorbent cotton on the end of a holder should take place after each time of feeding. Either simple (cool or tepid) water may be used, or, should the circumstances demand it, it may be rendered slightly alkaline or distinctly antiseptic.

Catarrhal Stomatitis.

Catarrhal stomatitis is the simplest of the inflammatory forms of sore mouth, and generally yields readily on the removal of the cause of irritation. In young infants we very often find more or less injection and painful swelling of the gum shortly before the tooth pierces it. This local form is best relieved by the frequent application of simple cool water to the gum, to which, if thought desirable, may be added a few grains of boric acid. Any additional irritation, however, at this time will probably cause a considerable extension of the inflammation. Lack of cleanliness in the mouth, in the feeding-apparatus, or in the food is one of the more common sources of trouble. Frequently the materials given to an infant to suck or bite on when teething are either of a fermentable character or are not kept in a cleanly condition. Epstein ascribes the frequency of this ailment in infants to the irritation of the air, especially when they are allowed to breathe through the mouth; to the mechanical act of sucking when there is any difficulty, either owing to the scarcity of milk in the breast or to nipples imperfectly developed; or to the natural tenderness of the epithelium in early infancy, and the often too energetic cleansing of the oral cavity on the part of midwives or others in charge of the child. Many authors regard the occurrence of the disease as an indication of impaired nutrition in the infant. There can be no question that in a weakened state of the system the mucous membrane reacts more quickly and to slighter causes of irritation than if the infant's health be more vigorous. Ascertaining the cause of trouble and removing it generally lead to a prompt subsidence of the trouble, especially if cleanliness of the oral cavity be maintained by gentle washing with a cool, soothing application, such as boric acid, in the proportion of 5 to 10 grains to the ounce; borax, 5 to 20 grains to the ounce; bicarbonate of sodium, 10 grains to the ounce; or, finally, chlorate of potassium, 5 to 10 grains to the ounce.

Should the inflammation appear more severe or be persistent, more astringent lotions will be indicated, of which perhaps the best is a solution of silver nitrate (from 2 to 5 grains to the ounce). The inflamed surface, after careful cleansing, ought to be gently pencilled with this solution once a day. Should any distinct spots of ulceration appear, they may be lightly touched with a silver probe armed with a small quantity of the mitigated stick of silver nitrate. By many physicians the administration of potassium chlorate is advocated in this affection. My own opinion agrees with that of Dr. Forchheimer,[1] that it is of little service and unnecessary, and therefore, on account of the risk attendant on its administration at a very early age, it should not be used. Occasionally, in young infants, this ailment is accompanied by pyrexia, and is associated with much restlessness and fretfulness on the part of the infant. To relieve the pyrexia small doses of aconite, potassium citrate, or any suitable fever mixture may be administered, to which bromide of potassium may be added if there is much restlessness. If this should fail, the careful administration of an opiate to relieve pain may be allowed. Dr. J. Lewis Smith recommends the application of a little borax, either with honey or with glycerin and water. A solution of alum (5 to 10 grains to the ounce) and a solution of tannin and glycerin (glycerite of tannin 2 drachms, water 1 ounce) have also been recommended, and may, if desired, be tried. Cysts in the mucous membrane, if they form, must be opened by free incision, and if necessary cauterization of their walls may be resorted to. If the general nutrition is imperfect, the infant's diet must be carefully regulated; the stomach and bowels must be gently stimulated for the more effective performance of their functions, and later on some bland ferruginous tonic should be administered, such as—

℞. Ferri et ammonii citrat., ʒss;
Pepsinæ glycerit., ʒiij;
Elixir. simp., ʒiv;
Aquæ, q. s. ad ℥j.—M.
Sig. A tea-spoonful three times daily, after meals.

In cases occurring near adult age the same general rules apply, although we shall find the sources of irritation to be of a different character. Sharp teeth, dental caries, ingesta too hot or too cold or too acid or too highly seasoned, the immoderate use of alcohol or tobacco, and the swallowing of any irritant, may all give rise to an attack of stomatitis. In these cases a simple bland diet must be ordered, which should be taken lukewarm or decidedly cool, as may be found most grateful

[1] *Arch. Pediatrics*, Nov., 1888.

by the patient. Should the stomach be irritated or the bowels constipated, a saline laxative may be ordered, followed by some simple alkaline bitter as a stomachic. The use of alcohol and tobacco must be interdicted; offending teeth are to be repaired or removed at once; at the same time some simple mouth-wash is to be used frequently during the day. Any of the solutions directed above will be suitable. Should pain be a prominent symptom, the mouth-washes may be made more emollient by using either gum-water, barley-water, or quinceseed-water instead of simple water in preparing them; a small quantity of an opiate may be added if necessary. Sometimes the gum behind the upper incisor is particularly complained of, and on examination it will be seen to be much swollen and extremely sensitive. Much relief will be obtained in these cases by gently pencilling it with a solution of silver nitrate (10 to 20 grains to the ounce), or with glycerin of tannin, or with tincture of rhatany.

Catarrhal stomatitis accompanies most of the exanthemata and continued fevers. Absolute cleanliness of the mouth, along with some slightly alkaline wash, fulfils all the indications, which in these cases must be quite secondary to the more important disease.

Aphthous Stomatitis.

In aphthous stomatitis we have a painful and very troublesome affection, of the exact pathology of which we are still uncertain. It is a more or less self-limited disease, with symptoms almost entirely local. Rarely, and only in children, have we any constitutional disturbance. In children, in the confluent form of the disease, we may have pyrexia with associated gastric or intestinal derangement, the mouth becomes hot and dry, and sucking or mastication is painful. In the treatment of this all sources of irritation must be forbidden; as mastication is painful, only soft food should be allowed. Demulcent mouth-washes may be ordered, such as mucilage of gum arabic, of slippery elm, of marshmallow, or of flaxseed, rendered slightly alkaline with sodium bicarbonate (5 grains to the ounce). If the pain is very severe, opium in small quantities may be added. After a few days the spots may be touched lightly with silver nitrate in stick or in solution (20 to 30 grains to the ounce), or if the ulcers are very numerous the surface may be brushed over lightly with a weaker solution (10 grains to the ounce). Baginsky[1] strongly recommends a solution of potassium permanganate as a mouth-wash. It may be given a fair trial, although I have not been able to convince myself of its special efficacy. Sodium salicylate (1 drachm to the ounce) has also been recommended in the confluent form, to be applied four or six times daily, especially after eating. Dr. J. Lewis Smith advises the appli-

[1] *Lehrbuch der Kinderkrankheiten*, Zweite Auflage, 1887, p. 595.

cation of iodoform in ethereal solution (2 drachms to the ounce), to be applied with a brush. If repair goes on slowly other astringents may be used. Among those most recommended are a solution of cupric sulphate (10 grains to the ounce), zinc sulphate (10 to 20 grains to the ounce), and potassium chlorate (10 grains to the ounce). In children small doses of potassium chlorate, largely diluted, may be given at intervals during the day. Any gastric or intestinal derangement must be rectified.

Stomatitis Parasitica.

In stomatitis parasitica, commonly known as thrush, there is an inflammation of the mouth due to the growth of a parasitic confervoid plant upon and between the layers of the epithelium. Its growth is favored by the existence of previous catarrhal inflammation or by any of the conditions tending to favor such an inflammation; by any undue acidity in the secretions of the mouth; and by debilitated states of the system. It develops most readily on epithelium of the squamous type, its mycelium penetrating between the individual cells and their several layers. The affection, with its concomitant inflammation, is entirely due to the presence of this parasite, on the removal of which the irritation quickly ceases and the parts resume their natural condition. Our efforts must therefore be directed to its destruction. To reach it, it is necessary to remove the upper layers of epithelium, and in doing so a certain amount of force is necessary. It will be found that the removal is more easily accomplished if the wash is rendered slightly alkaline.

The following solutions may be used: Bicarbonate of sodium, 15 grains to the ounce; borax, 30 to 40 grains to the ounce; or sulphate of sodium, 1 drachm to the ounce. Some physicians still prefer the use of borax and honey (sodii borat., 1 drachm; mellis, 3 drachms), gently pencilled over the spots where the growth appears; but as all saccharine solutions favor the growth of the parasite, it would seem as if the addition of either honey or syrup to these solutions can only be harmful. Should the surrounding mucous membrane appear very red and inflamed, a solution of silver nitrate (3 to 5 grains to the ounce), gently pencilled over the surface, will be found of much service, and if any small spots of ulceration appear in the denuded portions, they may be lightly touched with a probe armed with the mitigated stick.

In addition to efforts directed to the actual removal of the parasite, great care must be taken to place the patient under the most favorable hygienic conditions. If the infant is fed artificially, special instructions must be given to ensure absolute cleanliness in the preparation of food and in the feeding-apparatus. Feeding-bottles with tubes should be

discontinued, as they are impossible to keep clean. The food should be sufficiently nourishing and yet digestible, and should be given at regular intervals, while both before and after feeding or nursing the mouth should be thoroughly but gently cleansed with a weak alkaline solution. It must always be remembered that, as the disease is parasitic, the germs can be easily conveyed from one child's mouth to another's. In foundling and maternity hospitals constant care must be exercised in the inspection of each child's mouth, and no transference of bottles from child to child should be allowed. If the disease attains any headway, not only does the act of sucking become very painful, but deglutition may be rendered both difficult and painful, while in some few cases the œsophagus has been reported as blocked with masses of confervoid growth and epithelium. As it is extremely important that the nutrition of the child should be sustained, its nourishment must be given in a concentrated and more or less predigested state. Wiederhofer recommends in severe cases the administration of food through a funnel or tube inserted into the anterior nares; deglutition will be excited in a reflex manner when the milk or other fluid reaches the pharynx. Forchheimer[1] reports a case of œsophageal obstruction in which he was able to force a catheter gently through the mass of mycelium and spores into the stomach, and through it introduce some nourishment. Vomiting was induced and masses of the growth were thrown up.

In adults we may use the foregoing solutions as washes or sprays. Should there be much surrounding congestion of the mucous membrane, it is advisable to use the solution of silver nitrate early. As thrush occurs in adult life only in very debilitated conditions, its appearance is always an unfavorable omen, and prompt but gentle measures should be at once taken for its eradication. Forchheimer[2] says that calomel in small doses, or corrosive sublimate very much diluted, almost always acts as a specific in intestinal troubles which are due to thrush. The underlying conditions or disease in every case of thrush should receive the most careful attention.

Ulcerative Stomatitis.

In stomatitis ulcerosa there is severe inflammation of the mucous membrane, commencing generally at the free border of the gum, evincing a tendency to extend in all directions and to affect the deeper tissues, frequently loosening the teeth, and in severe cases leading to necrosis of the bone. A foul state of the mouth, due either to want of cleanliness or diseased teeth, is a strong predisposing cause, especially when associated with unhygienic conditions of life tending to depress the system, such as impure air, unhealthy food, and improper clothing. The inflammation gives rise to profuse salivation, which, mingling

[1] *Archives of Pediatrics*, Feb. 7, 1889.

[2] *Loc. cit. et supra.*

with the discharges from the ulcerated surface, becomes bloody and fœtid, and if swallowed may disturb both the stomach and bowels. Fortunately, we have in potassium chlorate almost a specific for this affection. It may be administered both as a gargle (10 to 15 grains to the ounce) and internally. The salt gives rise to some smarting pain when passing over the inflamed surface, but this is only momentary, and may be partly obviated by giving it in some demulcent fluid, such as mucilage of slippery elm or sassafras-bark, or associated with extract of liquorice. In addition to this, the patient must be ordered soft, digestible food, and, if possible, obtain plenty of fresh air. The functions of the stomach and alimentary canal must be maintained in a healthy state; afterward tonics, some suitable preparation of iron and quinine, and cod-liver oil, may be administered. Under this treatment the symptoms, as a rule, rapidly improve, the salivation diminishes, and the fœtid odor passes away. Sometimes, however, the fœtor is so great that it is desirable to have it lessened more rapidly. To this end some of the more distinctly antiseptic washes may be used alternately with that of the potassium chlorate, such as solution of potassium permanganate (2 to 4 grains to the ounce), solution of carbolic acid (5 grains to the ounce), solution of peroxide of hydrogen (1 to 3 drachms to the ounce), or listerine. Sometimes, although rapid improvement is made at first, yet the gums still remain in an unhealthy and spongy state, and the patient may complain of some slight fœtor, detectable during the night or early morning. In such cases it is desirable to pencil the gums lightly with an astringent solution. Perhaps none is better than the silver nitrate (10 grains to the ounce). Glycerin of tannin, solution of alum (15 grains to the ounce), or tincture of iodine may sometimes be of much service. If the disease still lingers, examine the teeth, and if any appear loose or the roots are diseased, it will be better to have them removed promptly. Necrosed bone must receive prompt surgical attention. Even after all the symptoms have passed away the physician must warn the patient to maintain due care and cleanliness for some months, lest relapse occur. In some children with every feverish disturbance of the system the affection returns. In such the germs have evidently not been thoroughly eradicated, and still linger in some of the recesses of the mouth. The persistent use of antiseptic washes and careful attention to the teeth will in time overcome the tendency. In scrofulous children we are apt to have a good deal of associated adenitis. If the inflammation is associated with acute rickets or scurvy, it rarely gets well until the constitutional symptoms are removed.

Occasionally the disease assumes a chronic character from the outset. The inflammatory symptoms are but slightly marked, there is no notice-

able increase in the salivation, and fœtor may be noticed only at intervals during the day. Such cases are but slightly amenable to the action of the potassium chlorate; for their cure they require good hygiene and regular cleansing of the mouth and teeth, while three or four times weekly the inflamed portion may be carefully pencilled with one of the astringent solutions mentioned above, preferably the silver nitrate. These cases require perseverance in treatment for some months, else frequent relapses will occur. It must always be borne in mind that this disease is contagious, and effective isolation must be maintained when it occurs in a family or in an institute.

Gangrenous Stomatitis.

In stomatitis gangrenosa we have to deal with a rapidly-spreading necrosis of the cheek, lip, or gum occurring in debilitated children, generally under unfavorable hygienic conditions, and oftentimes as a sequel to one of the eruptive fevers. Beginning at first in the inside of the mouth, its onset is apt to be unnoticed till a pungently fœtid odor attracts attention, when a sloughy-looking ulceration with a hard infiltrated base will probably be seen on the inside of the cheek or lip near the angle of the mouth. This rapidly, almost hourly, extends, so that within a day or two a large portion of the cheek, gum, and lip may be converted into a fœtid dark-brown mass. The vital powers are rapidly prostrated; the child becomes apathetic and refuses to take nourishment, and very shortly a septic broncho-pneumonia or diarrhœa terminates the case. Treatment must be prompt, and the first indication is to arrest, if possible, the destructive process, and substitute for it a healthy action. It is generally recommended that this be accomplished by the application to the affected part of one of the stronger acids, either nitric or hydrochloric, or of the actual cautery (Paquelin's or the galvanic). The application should be thorough and complete at first; short of that, the irritation induced may only favor the spread of the disease. By many the preference is given to the cautery, as being more under control, while its power of destruction is complete and immediate. Before using it the patient should have an anæsthetic, and all necrotic tissue should be removed with forceps and scissors. It is recommended that the operation be repeated as often as may be necessary, but not more frequently than once in twenty-four hours. After each cauterization the parts will be thoroughly washed with some antiseptic lotion (solution of mercuric chloride, 1 : 1000; solution of carbolic acid, 1 : 20; or solution of zinc chloride, 20 grains to the ounce;) then dusted with iodoform, iodol, or aristol, and a charcoal poultice applied. Many physicians, however, prefer less heroic treatment, and can apparently point to many successful cases in justification of their opinion. Dr. J. Lewis

Smith[1] recommends from trial the formula given by Drs. Evanson and Maunsell, quoting from their article as follows: "The lotion which we have found by far the most successful is a solution of sulphate of copper, as employed by Dr. Coates in the Children's Asylum. His formula is as follows:

℞. Cupri sulph.,	ʒij;
Pulv. cinchonæ,	℥ss;
Aquæ,	f℥iv.—M.

This is to be applied twice a day, very carefully, to the full extent of the ulceration and excoriations. The addition of the cinchona is only useful by retaining the sulphate of copper longer in contact with the edges of the gums." Dr. Smith adds: "A moment's reflection will show us that the above treatment is preferable, provided it is equally effectual in arresting the gangrene, to the treatment by the strong acid." Gerhard believes the best local application is the nitrate of silver if the slough is small in extent. If much larger, the best escharotic is the solution of iron perchloride, applied in an undiluted state. Dr. Scheck[3] says, "If sloughs are formed, they must be removed by scissors or knife, and an attempt made to restrict the further progress of the disease. Mineral acids, chloride of iron, and the actual cautery were formerly used for this purpose, but now the nitrate-of-silver pencil is rightly preferred. The pencil should be slightly pointed, and methodically pushed from one part of the slough to another till it comes against resistant tissue. This manipulation is to be repeated till the gangrene is limited or ceases." In a case mentioned by Lange the gangrene healed very quickly after the application of lint saturated in turpentine and changed frequently. Dr. C. J. Maguire[3] reports several cases treated successfully by the application locally of bismuth subnitrate. The mouth was washed every three hours with a solution of carbolic acid, and the bismuth dusted on afterward. Under this treatment, with the administration of iron and a generous diet, his patients recovered, although some of them seemed almost hopeless in the beginning. Dr. Sullivan[4] reports the successful use of a mixture of equal parts of liquor ferri subsulphatis and glycerin as an application. The necrosed portions were first removed; the mouth was then thoroughly washed with a solution of sulphate of copper (30 grains to the ounce), and afterward the subsulphate was painted over the affected part. The operation was repeated four times a day. In each case the gangrene was arrested within three

[1] *Dis. of Children*, 7th ed., p. 148.
[2] *Dis. of Mouth, Throat, and Nose*, trans. by R. H. Blaikie, Edin., 1886, p. 31.
[3] *N. Y. Med. Record*, Feb., 1883. [4] *N. Y. Med. Journal*, Aug. 23, 1890.

days after the first application. Treatment was continued for eight or ten days, and recovery was complete within two weeks." Dr. J. Lewis Smith[1] writes, "If, after employing the milder treatment for two or three days the gangrene continue to spread, strong muriatic acid should be cautiously applied by a camel's-hair pencil or small swab in such a way that it comes in contact only with the diseased surface. Its use should be immediately followed by an alkaline wash. Recently in the Foundling Asylum carbolic acid has been used as an escharotic in one or two cases, instead of the strong acids, and with such a result as to encourage its further use."

In addition to attacking the destructive process by one of the foregoing methods, it is necessary, above all things, to sustain the strength of the patient. Stimulants may be allowed as freely as can be borne, and concentrated foods, predigested if necessary, should be administered at frequent intervals. If unable or unwilling to take nourishment by the mouth, predigested food must be given *per rectum*. Septic infection must, as far as possible, be guarded against by frequent cleansing of the mouth and wound with one of the antiseptic washes (among the best are the solution of peroxide of hydrogen and Labarraque's solution, 2 drachms to the pint,) and afterward dusting with powdered charcoal, bismuth subnitrate, or aristol. If possible the child's head must be placed in a position to permit the freest possible evacuation of the discharges. Internally, Dr. West[2] recommends the use of potassium chlorate, principally for its topical action; caution should be exercised that a safe dose be not exceeded. Ferruginous tonics may undoubtedly be of service, and if well borne by the stomach tincture of the chloride of iron appears the most suitable, and should be given in large doses, frequently repeated. When the gangrene is arrested and the granulations begin to present a healthy appearance, the danger is usually past and convalescence is established rapidly. To favor the healing mild stimulating lotions are indicated—solution of boric acid (15 grains to the ounce), solution of zinc sulphate (2 grains to the ounce), or an ointment may be used containing 2 drachms of balsam of Peru and 1 ounce of vaseline. Care must be taken during the slow process of healing that adhesions do not form which would interfere with the movements of the mouth.

Mercurial Stomatitis.

Severe stomatitis, due to the toxic action of mercury administered therapeutically, is seldom met with in our day. As a rule, it may be prevented by the administration of potassium chlorate and by taking due precaution to ensure thorough hygiene of the gums and teeth. Mild cases subside on the withdrawal of the drug. If patients appear

[1] *Loc. cit.* [2] *Dict. Diseases of Infancy and Childhood*, 6th ed., London, p. 590.

very susceptible to its action and the symptoms appear threatening, it is a wise precautionary measure to have them removed from all possible influence of the mercurial preparations. If fumigations have been employed, the room in which they were taken should be abandoned. Locally, a similar treatment to that indicated in catarrhal stomatitis is called for. The mouth may be frequently rinsed out with warm, soothing washes (*vide* Catarrhal Stomatitis), to which, if there is much pain, opium may be added. Fœtor of breath may be relieved by the use of washes containing hydrogen peroxide (1 drachm to the ounce), Labarraque's solution (1 drachm to the ounce), or potassium permanganate (2 grains to the ounce). Internally, potassium chlorate may be given in 5- or 10-grain doses every three hours, either combined with tincture of chloride of iron or in decoction of cinchona. Should any ulcerations be present, they may be gently brushed with the solution of silver nitrate. The strength must be maintained by careful feeding, or, if necessary, by enemata.

Stomatitis Crouposa and Stomatitis Diphtheritica.

These call for no special treatment beyond that directed to the more important affection, and the reader is referred to the special article on Diphtheria.

ABNORMAL DENTITION.

Very rarely it happens that an infant is born into the world with one or two teeth already appearing in the gum. Such teeth are liable to irritate the mother's nipple severely, and we may be asked to remove them. This can be easily done if they are only connected to the gum by mucous membrane; but when they are set more tightly the operation becomes more serious, from the possibility that it may be followed by troublesome hæmorrhage which may be difficult to control. It will be a question in such a case, also, whether we might not be removing the infant's temporary incisors, which would not be replaced till the child reached its sixth or seventh year. For these reasons their removal is not to be recommended.

Many infants, especially those who are of a weak or nervous constitution, are liable to evince symptoms of irritation during the period immediately preceding or at the time of the eruption of the temporary teeth. At these times the infant may become peevish and fretful; its sleep be disturbed; there may be more or less pyrexia; and its digestion may be easily upset. With these symptoms a warm bath (85°–90° F.), in which the infant may remain about ten minutes, has often a very soothing effect, and if given shortly before its sleeping-time may induce a quiet and restful sleep. At the same time a mixture containing 1 or 2 grains of potassium bromide, with $\frac{1}{8}$ to $\frac{1}{4}$

drop of tincture of aconite to the dose, to be repeated every two hours, may assist the action of the bath. The greatest care at this time must be given to the infant's diet, which should be simple, digestible, and carefully adapted to its age. Over-feeding is to be avoided, and as far as possible regularity in feeding is to be maintained. The gums may be frequently examined for symptoms of stomatitis. If hot and tender, frequent applications of cold water or weak solutions of sodium bicarbonate (5 grains to the ounce) or sodium borate (10 grains to the ounce) should be made. Solution of cocaine (2 grains to the drachm), lightly brushed over the inflamed gum, has been spoken of highly, and may give temporary relief. When the gum is tense, tumid, and painful I have thought that lancing of the gum has sometimes given relief to the infant. The former measures are, however, to be preferred under ordinary circumstances. Many serious ailments have been referred to dentition as an effective cause. I would strongly urge the most careful physical examination and thorough sifting of evidence before such an unlikely supposition is admitted.

Dentition may be delayed and the deposit of enamel may be defective in infants suffering from rickets, or as a consequence of any severe illness affecting nutrition profoundly. The importance of good teeth to the growing child cannot be over-estimated. Little benefit is apparently to be derived from administering any of the so-called proximate principles of the tooth, but distinct advantage is obtained when we can improve general nutrition. To this end, in addition to abundance of fresh air and suitable food, cod-liver oil should be administered in doses easily assimilated. To this wine of iron or the ammoniated citrate may be added if there is any anæmia. The following is a useful formula for an infant of one year:

℞. Ferri et ammonii cit., ʒss;
Ol. morrhuæ, fʒj;
Pepsin. glycerit., fʒij;
Pulvis acaciæ,
Pulvis sacch. alb., *āā.* ʒij;
Aquæ, q. s. ad fʒiv.—M.

Sig. One tea-spoonful three times daily.

Suppurative Inflammation of the Gums.

This is known commonly as gum-boil or alveolar abscess. We have a localized inflammation, commencing generally on the dental periosteum at the bottom of a carious fang. It is very liable to go on to the formation of pus, which produces absorption of the alveolar wall, then breaks into the submucous tissue of the gum, and finally points at some place on the mucous membrane within the mouth. Treatment, if

possible, should be early. If the tooth be too much damaged to repair, it had better be extracted at once. If it can be saved, the diseased pulp in the fang should be removed, and the canal in the root cleared and thoroughly cleansed with antiseptic agents, then secured by temporary filling. At the same time, a preparation of iodine or iodine and aconite may be applied to the gum externally, or, if thought better, an incision may be made over the site of the inflamed root down to the periosteum. When suppuration has occurred in the fang-cavity an effort may still be made to secure its removal through the canal of the fang, but if it has burst through the alveolar wall its early evacuation into the mouth is demanded.

AFFECTIONS OF THE SALIVARY GLANDS.

Increased Salivation.

This is produced by any source of irritation in the mouth, and is therefore a frequent accompaniment of most of the inflammatory diseases above mentioned. It may, however, apparently arise from distant irritation, and has occasionally been met with in affections of the stomach, bowels, and uterus; rarely it has occurred as a symptom of lesion in the medulla oblongata or of the facial nerve. Occasionally it has been met with in otherwise healthy children between two and eight years of age apparently free from constitutional or local disease. In these latter cases it must be regarded as a neurosis. When arising from a known exciting cause our efforts will of course be directed to the removal of the source of irritation. In salivation of a neurotic form most benefit will probably be derived from the administration of iron or arsenic; at the same time belladonna may be used as a palliative with much probability of success. Dr. Finlayson reports a case of idiopathic salivation in a strong, healthy child of six years which was cured in a month by $\frac{1}{4}$ of a grain of extract of belladonna taken three times a day. Atropine sulphate may be used similarly in doses of $\frac{1}{120}$ to $\frac{1}{200}$ of a grain. If these fail, other nerve-sedatives may be tried, such as opium, chloral, or potassium bromide. The nutrition at the same time must be carefully maintained.

Dryness of the Mouth.

This condition is often a source of much discomfort, and does not yield readily while the cause is in operation. Sometimes small doses of potassium iodide give a certain amount of relief. Dr. Blackman recommends the use of $\frac{1}{20}$ of a grain of pilocarpine in a gelatin lamella, allowed to dissolve on the tongue, previously moistened by a

sip of water. He reports this as producing a slight flow of saliva for twenty-four hours, unaccompanied by excessive perspiration. The following is also a good formula for the administration of the same drug in the form of a lozenge:

℞.	Ext. pyrethr. fluid.,	♏ij–iij;
	Pilocarpinæ,	gr. $\frac{1}{32}$;
	Pulv. glycyrrhizæ,	gr. ij;
	Pulv. acaciæ,	gr. ij;
	Glycerini,	♏j;
	Sacchari,	gr. xx.

Mix well, and make into one lozenge, to be allowed to dissolve slowly in the mouth.

Idiopathic Parotitis.

Idiopathic parotitis is a condition commonly known as "mumps," in which we have to deal with a constitutional disease manifesting itself locally in an inflammation of the parotid gland; very rarely its associated glands, the submaxillary and sublingual, are also affected; occasionally it attacks, either by metastasis or as a sequence, the testicle in the male and the mamma or the ovary in the female. Constitutional disturbance is generally only slight, but sometimes the pyrexia runs high and pain is severe. The treatment in mild cases may be expectant. For the first few days at least, especially if the weather is cold and changeable, the patient should be confined to bed. The inflamed glands should be protected from the air by a layer of cotton wool secured by a silk handkerchief or light bandage, and gentle saline laxatives may be administered. If the patient is just reaching adolescence, there is perhaps more danger that the testicles or ovary will be attacked, and in such cases more caution must be exercised. Rest in bed for a week, or even ten days, would be the more prudent. If there be much pyrexia and local pain, tincture of aconite (U. S. Ph.) may be given in 2-drop doses for an adult every three hours, while locally to the swelling a mixture of extract of belladonna and glycerin may be applied and covered with oiled silk and cotton wool. If there is much restlessness at night, chloral or potassium bromide may be administered. I have several times used in these cases phenacetin or antipyrine in 5- to 10-grain doses twice daily, with considerable relief to the symptoms. Owing to the pain in movement of the jaw all nutriment should be given in soft, if not in liquid, form. In the early stages milk foods and light broths should be given; afterward, as there is a marked tendency to subsequent anæmia, the food should be more stimulating, and ferruginous tonics, with quinine and cod-liver oil, may be administered. Should

there be any indication of metastasis, the venous return in the affected part must be favored by position. In females a hot douche or sitz-bath may be taken. Leeching has been recommended as of service in relieving the pain of orchitis or ovaritis; four to six leeches may be applied to the inner border of the groin. Symptoms of meningeal irritation are occasionally met with, and must be combated by cold to the head and the administration of from 15 to 30 grains of potassium bromide, with tincture of aconite, every three to six hours, according to the severity of the symptoms. Rarely the swelling in the parotid becomes tense, red, and very painful, and the inflammation goes on to suppuration. In such cases poultices must be applied, and an incision made early in a horizontal direction parallel to the line of the important vessels and nerves, using caution to avoid them. In strumous children enlargement of the gland sometimes persists for weeks. Nerve-deafness following parotitis is usually incurable.

Secondary parotitis occasionally occurs as a sequel to other infectious diseases, especially those characterized by profound prostration. At the onset the application over the inflamed gland of lint dipped in the belladonna-and-glycerin mixture and covered with oiled silk and cotton wool may be of service. Should suppuration threaten, poultices must be applied and an early exit given to the pus, the cautions mentioned above being observed.

AFFECTIONS OF THE TONGUE.

Burns and Scalds.

These seldom call for much medical treatment. Sometimes the soreness persists, when a demulcent wash, rendered slightly alkaline by the addition of sodium bicarbonate or borate, and, if necessary, with a small amount of opium, may be used. Butlin recommends pencilling the affected surface with borax and honey. The sucking of small lumps of ice is generally very grateful.

Stings and Bites.

Such accidents are not often met with. A weak solution of ammonia may be used as a mouth-wash for the first day or two, in the hope of neutralizing the formic acid, the active principle of the poison. It may be afterward followed by a demulcent mouth-wash containing sodium bicarbonate (10 grains to the ounce), or by one containing salicylic acid (2 grains to the ounce).

Acute Glossitis.

Here we have to deal with an inflammation arising very suddenly, generally in persons whose health is more or less impaired. In its severer forms it seriously threatens life by the very great interference with respiration and deglutition. The symptoms generally reach their height on the third or fourth day, and terminate by resolution about the fifth or seventh day. In its milder forms glossitis demands little active interference beyond a smart saline purgative, and, topically, cool emollient mouth-washes, such as mucilage of slippery elm, of gum arabic, or quinceseed. To these may sometimes be advantageously added sodium borate (5 to 20 grains to the ounce) or alum (5 grains to the ounce) or ammonium chloride (20 to 30 grains to the ounce). If grateful to the patient, ice in small pieces slowly sucked may be of much service. If the symptoms are more threatening, free leeching may be employed between the hyoid bone and the angle of the jaw, followed by poultices to encourage oozing. If there is much swelling and both respiration and deglutition are seriously interfered with, Butlin[1] strongly recommends two free incisions into the substance of the tongue from behind forward, one on each side of the raphé, distant from it about two-thirds of an inch. They should be carried to the depth of about one-third of an inch, and can be best made with a very sharp bistoury, inserted into the mouth on the flat and then turned. The hæmorrhage is never serious unless the incision has been carried too deeply, and the moderate bleeding which occurs is decidedly beneficial. These incisions may appear deep at the first, but they become quite shallow when the organ has shrunk. Sometimes the inhalation of atomized water proves decidedly grateful. The water should not exceed the temperature of 160° F., and may be rendered perhaps more effective by the addition of compound tincture of benzoin. The application of a solution of chloride of ammonium (1 drachm to the ounce) through the steam-spray apparatus has sometimes proved very effective in favoring resolution (Cohen). The spray should be used for fifteen or twenty minutes at a time and repeated every two or three hours.

Sometimes the process goes on to suppuration, prolonging the duration of the disease and much increasing the local distress. Demulcent washes should be used as warm as can be comfortably borne, and as soon as the presence of pus can be detected free incision must be made and the abscess-cavity thoroughly washed out with some antiseptic solution. In these cases the pus is usually fœtid. Very rarely gangrene sets in, due generally to irritation from sharp or carious teeth. Such a condition will demand the greatest tenderness, and washes or sprays of

[1] *Diseases of the Tongue*, by H. T. Butlin, F. R. C. S., London, 1885, p. 42.

a solution of hydrogen peroxide, potassium permanganate, boric acid, or carbolic acid should be used at frequent intervals. Occasionally, when the swelling is very great, much difficulty is experienced in feeding the patient. This can sometimes be done by means of a tube through the nasal passages; at the same time predigested nutrient enemata must be carefully given. After resolution has taken place sufficiently to permit deglutition, ferruginous tonics, with quinine, should be administered, and of these the best is probably the muriated tincture of iron with glycerin. The chronic inflammatory thickenings which sometimes remain after an acute attack are not very amenable to treatment. If any source of irritation can be discovered in a sharp or carious tooth or an offending plate, it must be at once remedied; at the same time the spot may be painted with a weak solution of iodine. The general hygiene of the mouth must receive careful attention and all irritants must be avoided.

Occasionally *unilateral glossitis* is met with. It generally runs a mild course, and seldom demands the severer methods mentioned above.

Chronic Superficial Glossitis.

Chronic inflammation of the mucous membrane of the tongue is met with occasionally in persons subject to dyspeptic troubles or as the result of irritation produced by spirits, especially when taken raw, by tobacco, both smoking and chewing, by irregular or carious teeth, and by the frequent use of too hot or too cold drinks. The inflammation appears to affect principally the papillæ and mucous glands, leading in places to their almost entire disappearance. The mucous membrane generally is reddened, and very sensitive to any irritation. Occasionally the surface of the tongue appears as if it were mapped out in a series of more or less ovoid patches, smooth and glossy because denuded of papillæ, and separated by furrows or fissures reaching almost to the basement membrane. Conditions of this character are particularly difficult of treatment. The diet must be of the blandest character. It is sometimes desirable to confine the patient entirely to milk diet. Spirits and tobacco give rise to great distress, and must be entirely abstained from. The greatly-increased sensibility of the surface renders it very liable to frequent exacerbations; there must, therefore, be no relaxation in the absoluteness of the dietary. Should exacerbations occur, we may find the process go on to ulceration in places—a condition still more difficult to manage. The general health must be maintained at its highest level, but in the administration of tonics no irritating drugs should be allowed. Should there be much pain, demulcent mouth-washes to which opium has been added must be employed. Of local remedies, those which appear to relieve the patient more certainly and quickly than any others are solutions of chromic acid (5 to 10 grains

to the ounce) or the mel boracis of the Pharmacopœia (Butlin). It may be applied twice daily, gently brushed over the surface with a camel's-hair pencil. At the same time great care must be taken to have the mouth thoroughly cleansed after each meal. For this purpose Seiler's antiseptic and alkaline tablets may be used, one dissolved in a gill of tepid water, or the following:

℞. Sodii salicylat.,
Sodii borat., āā. gr. x;
Acidi carbolici, gr. j;
Glycerini, fʒi–ʒij;
Aquæ rosæ, q. s. ad fʒj.—M.
Sig. Use frequently.

Occasionally a chronic ulcer in the centre of a plaque of this chronic inflammation resists all treatment. Such cases may be rendered more endurable and the spot less sensitive by the application of glycerin of tannin or the solution of chromic acid. The application of any severe irritant or caustic should be avoided, for it must always be borne in mind that a considerable percentage of these cases terminate in epithelioma. The physician should therefore keep the patient under his inspection.

Leucoma.

Closely allied to the foregoing in its pathology and etiology is the condition known as "smoker's patch," and the more extensive, but very similar, affection known as leucoma or leucoplakia oris. Both of them may be said to be the expression of an irritant acting on a sensitive mucous membrane. In the smoker's patch we have a chronic inflammation of the small spot of mucous membrane where the pipe generally rests. At first there is only a slight thickening of the deeper layers of the epithelium. Afterward these peel off, leaving a spot between a quarter and half an inch in diameter, smooth, red, and looking as if denuded of papillæ. If seen thus early, soothing measures should be employed. If smoking is not altogether abandoned, the smoothest form of pipe must be used, and only the mildest tobacco, while the pipe should be placed on the opposite side of the mouth to which it has been previously used. The patch may be brushed twice daily with a weak solution of chromic acid. If the disease still shows signs of extension, tobacco and spirits in any form must be absolutely forbidden. All irritating articles of food must be excluded from the diet, which should be bland and simple in character, but nourishing. Any gouty, rheumatic, or dyspeptic condition must, as far as possible, be corrected. Topically, the spot must be brushed three or four times daily with the solution of chromic acid or with borax and honey, or with a weak solution of silver nitrate (10 grains to the ounce).

In leucoplakia oris we have either a more extensive distribution of minute patches very similar in character to leucoma, or we may have a large patch, white or bluish white in color, covering the greater portion of the dorsum; the inside of the cheeks and lips are also liable to be affected. The treatment of all these conditions must be very similar—the absolute withdrawal of all sources of irritation, a bland, unstimulating diet, and the employment of soothing mouth-washes. As a rule, the alkaline lotions give more relief in leucoma than any other application. The following may be used: potassium bicarbonate, 15 to 20 grains to the ounce; sodium bicarbonate, 20 grains to the ounce; sodium borate, 20 grains to the ounce.

Sometimes a very weak solution of alum (20 grains to the ounce) agrees well, or a solution of sodium chloride of the same strength. It will require careful trial to decide which remedy suits the special case, and when the tongue is very sensitive many trials may have to be made before the one which gives most relief is found. One general rule holds good for all cases of leucoma; namely, not to use caustics. Whatever danger there may be of the development of carcinoma is certainly increased by the employment of silver and other caustics (Butlin).

As regards general treatment, any debility or diathesis must receive special attention. If a cutaneous rash coexists, liquor arsenicalis may be of distinct benefit.

In connection with the above, Butlin says: "Warty growths appear to be the most dangerous of the conditions which actually and immediately precede cancer. I have no doubt that indurations and warty growths and very obstinate ulcers, particularly when they present the slightest increase of induration about their bases, ought to be removed freely and without delay by the knife."

Wandering Rash.—Occasionally in children a peculiar circinate but migratory rash is seen on the dorsum of the tongue. It does not appear to be due to any constitutional diathesis, nor is it associated with any local disorder that can be made out. It has no symptoms of its own. The condition does not seem to be affected by any medicines that have been given nor by any change in diet. Butlin says of it: "Unless the future brings with it a very different experience to the past, I shall continue to believe that this wandering rash is clinically a very insignificant disease, never likely to become serious, and that it undergoes spontaneous cure after it has existed a considerable period."

Black Tongue.—Very rarely a black discoloration, commencing about the middle of the dorsum, is met with, which gradually extends over the surface till it covers the greater portion, then in a few weeks it gradually disappears. It is apparently due to some parasitic condition. In its treatment there is little to be done. Many washes and local applications have been used without any permanent benefit.

The patients generally appear to be in poor health, and tonics given to improve it have seemed to exert a good effect. The discoloration is not accompanied by local symptoms.

Ulcers.

Occasionally, grouped about the neighborhood of the tip of the tongue, may be seen a few small superficial ulcers, very tender and irritable; sometimes with sharp-cut edges, at other times less defined. They are generally met with in patients who suffer from gastric irritation. As a rule, they yield readily to an unirritating diet, stomachics, or gentle laxatives and a soothing gargle. If they persist, their surface should be gently brushed with a solution of chromic acid (5 grains to the ounce) or silver nitrate (10 grains to the ounce).

Ulcerated surfaces and fissures, simple in character, due to the irritation of some offending tooth or artificial plate, are occasionally met with. The source of irritation must be removed at once, and the raw surface gently washed with some weak antiseptic lotion, as solution of boric acid (10 to 15 grains to the ounce). If there is much pain, the following lotion may be brushed over the surface several times daily:

℞. Chloralis,		gr. x;
Glycerini,		gr. x;
Aquæ,	q. s. ad	f℥j.—M.

If the progress toward repair is slow, the edges may be touched lightly with a stick of silver nitrate or the surface may be brushed with a solution of chromic acid (10 grains to the ounce) or of (sulphate of copper of the same strength). Butlin warns against the over-irritation of a sore of this character in persons more than fifty years of age, lest it may develop into carcinoma. Should it persist notwithstanding these measures, the best course will be to have it removed, and with it an area of at least one-quarter of an inch of healthy tissue. The general health should receive attention.

Syphilis.

The manifestations of syphilis are very frequently met with in the mouth. Here, as in all forms of syphilis, constitutional treatment must play the most important rôle, and the reader is referred to the article on that subject. It will be sufficient to add that in those forms of the disease in which little local damage occurs it will be only requisite to use that form of treatment which suits the general disease; but when we have to deal with rapid destruction of tissue, as met with occasionally in phagedenic ulceration, the quickest possible results are

to be obtained. Not frequently do we meet with a *primary sore* on the lips or tongue as the result of infection from some unclean substance conveying contagion, such as pipes and cigars, or from kisses by persons with an infectious sore on the lips. In the treatment of these the principal reliance must be placed on mercury, administered for its constitutional effects. At the same time we may use soothing applications to the sore itself. A lotion of black wash is often very suitable, or the sore may be dusted lightly with powdered calomel. Should it show symptoms of any phagedenic action, the application of nitric acid may be called for.

Of the *secondary manifestations*, mucous patches are very frequently seen on the inside of the lips, especially the lower lip; on the inner surface of the cheek, often in the neighborhood of the last molar teeth; and on the sides of the tongue. *Fissures* may occur at the angles of the mouth in connection with the mucous patches on the inside of the lip, and at the borders and tip of the tongue, where it is exposed to the friction of the teeth, ulceration may take place. These lesions, as a rule, are readily affected by local treatment, but very slowly yield to constitutional measures only. Butlin says: "I have treated patients with mercury for several months in succession without curing or greatly altering the sore places on their tongues. With the mercury I have then employed local treatment, and have seen the sore places disappear within a week. Again, I have treated the patients with the same local measures from the commencement, and have cured the sores within a week or ten days. On this account I look on local treatment as essential to the rapid cure of these affections." He strongly recommends the application of a solution of chromic acid (10 grains to the ounce), which he directs to be painted over the affected part three or four times a day by means of a camel's-hair brush. Scheck[1] directs the patches to be touched with a stick of silver nitrate, and afterward prescribes mouth-washes containing chlorate of potassium, tincture of rhatany, or boric acid. Cohen calls nitrate of silver the sovereign local remedy for all syphilitic ulcerations of the mouth. Many surgeons, however, prefer the light application of either the pure nitric acid or the solution of acid nitrate of mercury. In addition to local applications, the physician must insist on complete abstinence from the use of tobacco in any of its forms, and the mouth should be kept in a cleanly condition by the use of some slightly alkaline and antiseptic wash, used regularly after each meal, such as a solution of Seiler's antiseptic tablets.

Tertiary syphilis manifests itself in the oral cavity by gummata and scleroses. To the breaking down of the gummata, either superficial or deep, is due the formation of the ulcers and fissures which are met with in this stage of the disease. Gummatous ulcers may remain in

[1] *Loc. cit.*

an indolent condition for long periods. Such ulcers require careful stimulation, and perhaps the nitrate-of-silver solution (20 to 30 grains to the ounce) forms one of the most effective applications if carefully brushed over the surface. At times the ulcers become inflamed and extend or become phagedenic, eating away a large portion of the tongue. In such cases the constitutional treatment must be pushed, and the dose of the iodide, if well borne, should be increased to 20 or 30 grains, or even a drachm, three times a day. At the same time, tonics, such as quinine and cod-liver oil, may be ordered. Locally, gentle cleansing applications will probably be best borne, such as boric acid or weak solutions of chlorate of potassium (10 grains to the ounce). Occasionally potassium iodide is not tolerated. In these cases sometimes one large dose given through the day agrees better than the divided doses. If this plan fails, recourse must be had to mercury. Butlin[1] recommends solution of mercuric chloride, with the insufflation of a powder containing finely-powdered iodoform 1 grain, morphine $\frac{1}{6}$ grain, powdered borax or oxide of zinc 3 grains. Before the powder is applied the surface of the ulcer or fissure must be carefully cleansed with a warm solution of mercuric chloride (1 : 2000), then dried, and the powder insufflated thickly over every part of the sore.

In the scleroses of tertiary syphilis, if seen before contraction takes place, much improvement is to be expected from potassium iodide: 10 or 15 grains three times a day, with or without small doses of mercuric chloride, may be given to commence with, and if a decided effect is not speedily produced, the dose may be increased rapidly to 25 or 30 grains. Local treatment is not necessary. If contraction has taken place, no treatment will be of much avail beyond the palliation of symptoms as they arise.

Tuberculosis is frequently met with in the posterior parts of the mouth as a secondary manifestation of disease elsewhere. In these cases this local manifestation rarely gives rise to important symptoms. Any irritation arising may be relieved by the application of astringent or anodyne washes or sprays. Occasionally, however, we meet with localized areas in the anterior part of the mouth, generally on the tip of the tongue or on the upper surface of one side, appearing in their early stage as small circumscribed nodules. These may be secondary to disease elsewhere, but occasionally appear to be primary. The mucous membrane over these nodules sooner or later ulcerates, leaving deep ulcers with overhanging edges. These maintain their atonic character, rarely heal, and gradually extend, and are a constant source of danger to the whole system. In reference to their treatment Butlin[2] says: "I am strongly in favor of removing every tuberculous ulcer of the tongue which appears to be primary while it is still of

[1] *Loc. cit.* [2] *Loc. cit.*

small size and easily within reach of operation, as it may preserve the patient from further tuberculous disease by infection through the ulcer. The operation is not formidable, and will probably save the patient a great deal of distress. I am prepared to go even farther, and to remove a secondary tuberculous ulcer if it is limited and small, if the associated disease is not advanced, and if the operation is likely to be well borne; and I would urge the operation, not with a view to cure, or even to greatly prolong life, but in the hope of saving much distress." He strongly advises excision in preference to the cautery. Should, however, an operation be refused or deferred, it is necessary to fall back on local treatment. This should be unirritating; caustics are to be avoided. Most relief is to be obtained by demulcent or weak alkaline lotions:

℞. Sodii bicarbonat., gr. x;
Acidi carbolici, gtt. ij;
Aquæ, q. s. ad f℥j.—M.

Or,

℞. Sodii bicarbonat., gr. xj;
Thymol., gr. j;
Aquæ, q. s. ad f℥iv.—M.

Or,

℞. Acidi boric., gr. x–xv;
Aquæ, q. s. ad f℥j.—M.

Iodoform in powder may be dusted over the surface in the following manner: The surface of the ulcer is to be thoroughly cleansed with a stream of warm water, containing potassium permanganate (2 grains to the ounce) or boric acid (10 grains to the ounce); then thoroughly dried with absorbent cotton and dusted thickly with the following powder:

℞. Pulv. iodoformi, gr. j;
Morphinæ sulph., gr. $\frac{1}{6}$;
Acidi boric., gr. iij.—M.

This may be repeated two or three times a day. If thought better, aristol instead of the iodoform may be used with morphine. Dr. Steward has found Schwimmer's formula of papayotin of much service when the iodoform application had failed:

℞. Papayotin., ℥ij;
Glycerini,
Aquæ, āā. f℥j.—M.
Sig. Apply five or six times daily.

Lactic acid is also of service. The method of using this in Joseph's clinic in Berlin is as follows: It should be well brushed over the surface of the ulcer with a stiff brush until bleeding is produced, beginning with a 30 per cent. solution in glycerin. If very painful, a previous application of cocaine may be made. A gargle of precipitated chalk is subsequently to be used by the patient. The application is to be repeated every four or five days, and the solution of lactic acid is gradually increased to 50 per cent. Afterward, when showing signs of healing, some gentle astringent may be used or the surface may be dusted with a powder containing equal parts of aristol and bismuth subnitrate.

If we have to deal with tubercle in a syphilitic subject, Scheck agrees with Nedopil that at the beginning of the disease an antisyphilitic treatment may be of decided utility, but later on, when the ulcers take on more of a tuberculous character, it is quite useless. If pain and salivation are very great, it may be advisable to divide the lingual nerve. While carefully using these local applications, all proper constitutional remedies must be employed against the disease. The diet, while very nourishing, should be soft, to avoid painful movements of the tongue.

Carcinoma.

In carcinoma little can be done by medicine except to palliate, but there are cases in which patients refuse an operation or in which the disease recurs, and the physician will be required to effect some alleviation of the suffering. The principal indication is to relieve pain. Our main reliance must be on the insufflation of a powder containing either iodoform and morphine or aristol and morphine. The powder should be applied with, as far as possible, the same precautions as were directed to be used in the tuberculous ulcer, and should if possible be blown on the precise spot where the pain is most acute. In the amount of morphine to be used the physician must be guided by the circumstances. For the fœtor the mouth may be washed either with a solution of peroxide of hydrogen or with a solution of potassium permanganate or with creasote-water, or the vapor of creasote may be inhaled. The following is Mackenzie's formula:

℞. Creasoti, ♏lxxx;
Magnesii carbon. levis., gr. xxx;
Aquæ, q. s. ad f℥j.—M.
Sig. One tea-spoonful to be added to a pint of water at the temperature of 160° F.

In feeding the patient, as every movement of the tongue may give

intense pain, the food must be soft, or, if finely minced, may be swallowed with a mouthful of fluid. It is well to commence early with enemata of predigested nutriment. If hæmorrhage ensue, lint may be soaked in a little Monsel's solution and applied with gentle pressure after blood-clots are, as far as possible, removed. If this is not practicable, a tea-spoonful of the following solution may be slowly sipped, retaining it as long as possible in contact with the bleeding surface :

℞. Pulv. acidi tannic.,		gr. ʒvj ;
Pulv. acidi gallic.,		gr. ʒij ;
Aquæ,	q. s. ad	fʒj.—M.

Tincture of hamamelis may also be given internally, 15 to 20 drops every three hours, and applied locally as a gargle with water—1 drachm to the ounce.

ACUTE AND CHRONIC GASTRIC CATARRH, GASTRIC ATROPHY, GASTRIC ULCER, GASTRIC CANCER, AND GASTRIC DILATATION.

By D. D. STEWART, M. D.

General Considerations.

The degree of success encountered in the diagnosis and in the subsequent management of the several affections with which it is the writer's province to deal depends so largely upon a general knowledge of the physiology of gastric digestion, as well as upon the correct employment of modern chemical manipulative methods, that a résumé of these must form a not unimportant part of this article.

Until very recent years gastric affections have been dealt with empirically only: formerly we could but conjecture as to the secretory, motor, and absorptive efficiency of the stomach, and our conjectures, based on no definite pathognomonic symptomatology, were often fallacious and led to harmful medication. Thus cases of fermentative hyperacidity were not infrequently regarded as those of pyrosis hydrochlorica, and we were wont to treat digestive disorders with pepsin and acid, whether accompanied by an increase or diminution in the gastric secretion. It was not unlike the practice formerly in vogue of diagnosticating Bright's disease, and routinely prescribing Basham's mixture in all instances in which albumin was discovered in the urine, irrespective of the underlying cause. But as the microscope and more comprehensive chemical tests in cases of albuminuria permitted the differentiation of functional from organic kidney affections, and gave a more correct insight into the character of the underlying morbid processes, so the more modern employment of the stomach-tube for purposes of diagnosis has effected a complete change in our methods of separating gastric affections, removing them from the uncertain ground of empiricism and placing them and gastro-therapeutics on a new and rational basis.

The form of tube best adapted for use both for removing a portion of the stomach-contents for diagnostic purposes and for lavage is that of soft black rubber, open at the tip, with one or more small oval

"velvet-eyed" fenestra in the walls immediately beyond its extremity. While it is desirable that these fenestra be of moderate size, they must not be large enough to render the tip of the tube so pliable that it will bend upon itself during introduction. This form of tube of soft rubber, open at the tip, with a fenestrum or two in its lateral wall, is that now in general use both in this country and abroad, it having entirely superseded the stiff rubber sound, which, though easier of introduction in the first portion of its passage in subjects who are unable to co-operate with the physician through lack of intelligence or excessive faucial irritability, possesses several decided disadvantages which have caused it to be abandoned in favor of the more flexible sound. A tube of red rubber is sold in the shops with both open and closed tip, the open tip having a bevelled edge and "velvet eye," as have the fenestra. As it is a trifle less flexible than the black tube, it can therefore be more readily introduced: while it is often necessary for the patient to swallow several times to ensure the entrance of the latter to the stomach, the former may be pushed onward by the operator without this. Unlike the stiff sound applied with the stomach-pump, its use is practically without danger in diseased conditions of the stomach, and it may therefore be employed where the other cannot be readily introduced. A closed-tip tube with eyes in the lateral walls is preferred by some, who believe it is less likely to become obstructed than that with the open tip. The writer has used both forms, and finds that one is about as satisfactory as the other. Tubes of varying length and size are to be had in the shops. Many consist of two portions, the gastric extremity joined to the other at a distance of about three feet by a piece of stout glass tubing. If these are of red rubber, the distal extremity is usually made a trifle more flexible than the gastric, and has joined to it a hard-rubber funnel of about 6 ounces capacity. One form of black rubber tube above mentioned has a length of about 5½ feet—much longer than is necessary except for lavage. It has an expanded extremity through which liquids may be introduced without the necessity of attaching a separate funnel, and for that reason is very convenient.[1] The writer now uses largely tubes of this sort of a diameter of one-third of an inch for lavage, as well as to siphon the contents of the stomach for diagnostic purposes; but on purchasing separates them at a distance of one metre from the stomach end, this length being ample for withdrawal of the stomach-contents in all cases. For lavage he joins the ends by means of a short piece of strong glass tubing, and thus uses the entire length of tube. The

[1] These tubes have at a distance of about 40 cm. a narrow band about them as an indication of the depth which the tube should enter in cases in which no or slight dilatation exists. This, though of service as a guide, often has to be disregarded, depending upon the level at which the outflow occurs with most readiness.

interposition of the glass tube has obvious advantages in lavage, besides that by it one can thus use the same tube both for diagnostic and therapeutic purposes. For lavage it is desirable that the tube after introduction should be sufficiently long to reach several feet below the level of the stomach, that ready siphonage be obtained, as will be explained on another page. For removal of some of the stomach-contents it is merely necessary that the distal extremity of the tube should be a few inches below the stomach level.

Preceding the introduction of the tube until the patient becomes more or less habituated to its use, it is a good plan in sensitive subjects to render the pharyngeal wall, especially the right half, moderately insensitive by means of cocaine. This may be applied in solution with a brush, by atomization, or, as the writer prefers, through a medicine-dropper, using a 2 or 3 per cent. solution, about a half drachm or more being deposited upon the right pharyngeal wall while the patient is sitting with mouth open and head thrown backward and inclined to the right side. The cocaine solution is retained for a few seconds in the pharynx, and then swallowed. This will render the pharynx, œsophagus, and stomach more tolerant, and will largely obviate retching, so common when the tube is used the first time or two. This tendency to retching in some cases not only renders the introduction of the tube very difficult, but it may, when very decided, entirely defeat our object—that of obtaining a sample of the usual gastric secretion. For where some little time is consumed in its introduction through the patient insisting on its being removed after it has engaged the œsophagus, the continuous retching may produce a reflux of bile from the duodenum into the stomach, and often, when retching has been pronounced during the introduction of the tube, and when more than the usual time has been consumed in inserting it, the writer has found the fluid withdrawn from the stomach very deeply stained with bile, and greater in quantity than it would have been had the tube passed readily.[1] The introduction of the tube is usually simply and rapidly done, provided the intelligent co-operation of the patient is obtained. He should sit erect, with head thrown back and mouth open. The tube is held in the right hand within a few inches of the gastric extremity, as one would hold a pen-holder; its first few inches having

[1] For this reason, when retching is easily induced by the use of the soft black tube, though cocaine has been resorted to in the manner described, it is better to employ the somewhat stiffer red tube already mentioned. This last possesses theoretically the disadvantages that, being a trifle less flexible, it may, by irritating the stomach-wall more than the softer tube, yield untrustworthy results in cases in which it is desired to remove a specimen of the gastric secretion in the fasting condition, and that in cases of ulcer may do damage to the latter. These objections are offset by the greater advantage that it can be introduced with more celerity and with less systemic disturbance.

been moistened with water,[1] it is guided over the root of the tongue to the pharynx, and beyond the epiglottis toward the œsophagus by the index finger of the left hand. Should it not promptly enter the œsophagus and pass the cardia, it must be rapidly pushed forward with the right hand, the patient being directed to swallow. Having once engaged the œsophagus, it can be pushed onward into the stomach with facility. The patient should be informed that he cannot by any possibility choke. If suffocation seems pending or should retching begin, he should be told to inspire deeply. Thus directed, the tube will at once enter the stomach. A slight gurgling is usually heard on the tube reaching the stomach, due to the passage of air into it from that viscus. There is no danger of the tube entering the trachea by mistake if ordinary care is exercised in introducing it. The operator, however, can readily assure himself that this has not occurred by compressing the tube and directing the patient to breathe, which would be impossible had the tube entered the larnyx. While swallowing the tube is an easy matter with some persons after a trial or two, with others, especially nervous females, it is occasionally almost an impossibility by reason of the nausea, vomiting, and general distress attending its entrance into the pharynx, which may necessitate the abandonment of the procedure. Should brushing the throat with a strong (10 to 20 per cent.) solution of cocaine immediately before its introduction not prevent the occurrence of these symptoms, it is better not to persist in its trial, especially if gastric ulcer be suspected, as the violent retching and vomiting might induce hæmorrhage. A gargle of potassium bromide used several times daily for a short time preceding the introduction of the tube will assist materially in allaying nausea due to mere faucial irritability. The tube should not be used if hæmatemesis has recently occurred or if a thoracic aneurism is suspected. The presence of ulcer itself does not preclude the use of the soft tube.

In removing the tube care should be taken to compress it tightly before it has been withdrawn from the œsophagus, so that by no possibility can any of the contents pass into the larynx.

The stomach-contents are removed by epigastric pressure (method of Ewald and Boas) or by aspiration: the former is effected by causing the patient to make forcible voluntary contraction of the abdominal muscles, steady pressure being applied to the epigastrium; the latter, by attaching to the extremity of the tube below the level of the stomach some form of suction apparatus, such as a small syringe or a more elaborate aspirator. The writer has not found the expression method so

[1] Moistening the tube is not actually essential, there being sufficient mucus in the pharynx to lubricate it; if desired, however, the gastric extremity may be first dipped in water. Oil, glycerin, or milk is unnecessary, and should not be used when the tube is introduced for diagnostic purposes.

uniformly successful as that by aspiration, which he now invariably practises in the following manner: He attaches to the extremity of the tube, which should be of sufficient length to reach below the level of the stomach, a wide-mouthed 8-ounce bottle with a rubber stopper containing two perforations in which glass tubes are inserted, one reaching quite to the bottom, the other extending about an inch below the level of the stopper; the outer extremity of each is bent at a right angle.[1] The stomach-tube is attached to the outer extremity of the longer glass tube, and a hand-bulb syringe, minus its metal or hard-rubber extremities, to the other, in such a way that a sufficient exhaust of the bottle can be readily accomplished. This is done after the tube has been inserted and its outer extremity brought with the bottle below the level of the stomach. A vacuum being created and maintained in the bottle in this position, the contents of the stomach pass through the tube into it. Should doubt exist as to the stomach being full, and no flow occur after the tube is inserted to the depth at which prior physical examination has shown is the lower level of that viscus, it should be passed farther into the stomach and then gradually withdrawn, the glass tube being carefully watched to note the onset of the flow; if none occurs, it is probable that the fenestra are obstructed. A bulbful or so of air should be pumped through the tube, either by reversing the syringe on the bottle or by attaching it directly to the stomach-tube. If, following this aspiration, nothing is obtained, a small measured quantity of tepid water may be thrown into the stomach and at once aspirated off. Food-elements if present will probably return with it. The time occupied in the evacuation of the stomach should be as brief as possible, both for the sake of the patient's comfort and to avoid errors likely to arise through the local stimulating effects of the tube on the gastric mucous membrane.

Various methods have been proposed by which the condition of gastric secretion could be arrived at without a resort to the tube. The most practicable of these seems that of Einhorn's. Einhorn[2] has devised an apparatus which he styles a stomach-bucket,[3] consisting of a small oval silver vessel ($1\frac{3}{4}$ cm. long, $\frac{3}{4}$ cm. wide), on the top of which is a large opening with an arch over it. To the latter a stout and long

[1] This is an ordinary inhaling-bottle, such as is sold by oxygen-dealers; a similar appliance can be easily made, using a bottle of any desired capacity. This possesses an advantage over the syringe or the valveless bulb attached to some stomach-tubes, that aspiration can be more surely effected and with the same freedom from injury to the gastric mucous membrane. The bottle stopped by an ordinary cork serves to transport the removed contents to the laboratory should the operation have been done away from it.

[2] *Medical Record*, N. Y., May 19, 1890.

[3] This is manufactured by Messrs. John Reynders & Co. of New York City.

silk thread is tied, and at the distance of 40 cm. from the bucket a knot is made in the thread. The vessel is placed on the root of the patient's tongue, and he is told to swallow once. In a half minute or so the bucket reaches the stomach, of which we are certain by the knot coming into the mouth. After remaining in the stomach about five minutes it is withdrawn. In its removal resistance felt at the introitus œsophagi is overcome by having the patient expire deeply or swallow once. This method is very ingenious, and, according to Dr. Einhorn, very successful. He suggests that by it can be determined also the permeability of the œsophagus, the distance of the cardia from the teeth, its patulousness, and, partly, the condition of the gastric peristole, by noting the force with which the thread is pulled farther in. The method should be of more utility in cases of suspected ulcer, when the occurrence of hæmatemesis renders the use of the tube inadvisable. Mucus may be prevented from filling the bucket above the stomach by closing its opening before its ingestion with a thin gelatinous capsule. The vessel may require to be reintroduced several times if a negative response occurs to tests for free hydrochloric acid. Should there be no response, it would be preferable to remove the contents of the stomach through the tube in the usual way.

The functions of the stomach that necessitate investigation in order to establish a proper basis for the application of rational therapeutic measures are the secretory, motor, and absorbent. So intimately related are these that a disturbance in one is soon succeeded by a like departure from the normal in the others.

The secretory function involves the elaboration by certain portions of the glandular apparatus of the mucous membrane of pepsin-hydrochloric acid and a milk-curdling ferment.[1]

The principal office of the former is the solution and more or less complete digestion of albuminoids. The latter is accomplished by a process of hydration perhaps similar in type to the transformation of starch by diastase. The chief end-product of the digestion of albuminoids is peptone, yet, as the researches of Kühne, Chittenden,[2] and others have shown, but a minimum amount of true peptone seems to result even through the long-continued action of pepsin-hydrochloric acid digestion. Between the albuminoids and the final product of their digestion, true soluble peptone, there are a number of intermediate

[1] Though HCl will coagulate milk by uniting with the alkali of the casein, which keeps the latter in solution, and will thus cause its precipitation, the milk-clotting ferment of the gastric juice is quite distinct from either pepsin or HCl. The researches of Johnson, Boas, and Klemperer indicate that it is first elaborated as a zymogen, which is transformed into the milk-curdling ferment by the action of HCl and also by the organic acid. (*Vide* v. Jaksch, *Clinical Diag.*, p. 95, London, 1890.)

[2] "On the Relative Formation of Proteoses and Peptones in Gastric Digestion," *Journal of Physiology*, vol. xii. No. 1, 1891, p. 12.

substances, some of which until recently were regarded as identical with peptone.

The first issue of the gastric digestion of albuminoids is probably syntonin or acid albumin, a compound of hydrochloric acid and albumin. This is subsequently converted into the albumoses (or proteoses),[1] and some of these finally into the ultimate product of peptic digestion-peptones. For the proper solution and transformation of proteids into proteoses and peptones, to fit the latter for absorption, and that portion of the former which possesses a low diffusibility for tryptic conversion into the more soluble peptones, a definite secretion of pepsin and acid is necessary.

Pepsin,[2] which is formed in the chief cells of the tubules, principally those of the cardia, is not found in these except as a pro-enzime, pepsinogen or propepsin. It exists as the latter in the granules of the cell, and undergoes conversion into pepsin through the action of hydrochloric acid (or sodium chloride).

Pepsin is a hydrolytic ferment which can display activity only in the presence of an acid.[3]

The rapidity of digestion is directly proportionate to the amount of pepsin (within limits) in the digestive mixture. Pepsin possesses, like the other digestive ferments, extraordinary continuous activity. Very little is consumed in the digestive process. With the acid maintained in uniform amount, fresh albuminoids are attacked and dissolved when those previously acted upon are disposed of.

The most vigorous proteolytic action takes place with hydrochloric acid in the proportion of from 0.1 to 0.2 per cent. Unlike the case with pepsin, the acidity, though varying[4] considerably during

[1] The latter, which formerly were regarded as a single body, propeptone, have been shown by Kühne and Chittenden to consist of at least three substances, proto-, hetero-, and deutero-albumose, each of which, in the order named, progressively approaches peptone, and may be distinguished from the other by appropriate tests. (Kühne and Chittenden, *Zeitschrift für Biologie*, Bd. xix. 159, 1883; xx. ii. 1884; and xxii. 409, 1886; Kühne, *Verhandl. des Naturhistor. Medic. Vereines zu Heidelberg*, No. 1, iii. p. 286; and Chittenden, *Journal of Physiology*, vol. xii. No. 1, 1889, p. 12.)

[2] Acetic and lactic acids also possess the power of converting propepsin into pepsin and lab-zymogen into lab-ferment; so that if HCl be wholly absent these ferments may be found. (See Johannessen, "Studien über die Ferments des Magens," *Zeitschrift f. klin. Med.*, Bd. xvii. 1890.)

[3] Though HCl is the acid of the gastric juice and is essential for vigorous digestion, proteolytic action will go on without HCl in presence of other acids. Chittenden (*Med. News*, Feb. 16, 1889, "Observations on Digestive Ferments") found proteolysis active in presence of a 0.6 to 2 per cent. oxalic acid, 0.2 per cent. nitric acid, and 0.3 per cent. sulphuric acid. With the above percentage of nitric acid four-fifths as much proteids were dissolved as in presence of 0.1 per cent. HCl. Lactic acid possesses only one-sixth to one-third the power of HCl, while acetic and butyric acids he found have no digestive action.

[4] Chittenden found by quantitative trial that by using a pepsin of moderate strength and blood-fibrin as the proteid, the most vigorous digestive activity took place in the

digestion, displays a tendency to maintain a certain fixed average. Should this be increased or diminished by the addition of acid or alkali, the mean is restored automatically, either by cessation in or an increase of secretion;[1] but, though free hydrochloric acid is usually present in the gastric juice to the extent of 0.15 to 0.2 per cent.—and vigorous proteolytic action is impossible without it—only at a certain stage of digestion is it found to approach this amount, while during a portion of the digestive period it seems to exist only in combination with other substances, and the time of its appearance as free acid after food depends on the amount and character of the aliment ingested.[2]

Thus, after a light meal consisting of a few pieces of bread or a roll and water or weak tea,[3] the reaction for free hydrochloric acid is usually obtained in from half an hour to forty-five minutes, while that for lactic acid and acid phosphate appears within ten to fifteen minutes. Lactic acid continues to be present for nearly an hour, until free hydrochloric acid appears in appreciable quantities, after which hydrochloric acid is the only free acid present. After a more generous and varied meal[4] free hydrochloric acid is not recognizable until within four or five hours, and the lactic-acid period of digestion persists from the onset of the digestive act for two hours or longer.

The digestive period may therefore be divided into two stages, the duration of each of which is variable, depending upon the amount and character of the food taken. During the first, which usually

presence of 0.1 per cent. free HCl. ("Observations on the Digestive Ferments," *The Medical News*, Feb. 16, 1889.) Roberts (*Diet and Digestion*) noticed no difference in result between any proportion of acid varying from 0.1 to 0.3 per cent. HCl. But, as stated by Chittenden (*ibid.*), the strength of acid best fitted for digestion depends somewhat upon the amount of ferment present and the character of the proteids to be digested.

[1] Richet, *Du Suc gastrique*, Paris, 1878.

[2] Secretion of HCl occurs immediately on the entrance of the ingesta into the stomach, but the non-appearance of it as free acid for a more or less considerable time after eating depends upon the fact that HCl, like other mineral acids, has the power to decompose salts of the organic acids, which, present as lactates, neutral or basic phosphates, unite with HCl, forming a chloride of their base, liberating the organic acid. This sodium lactate or neutral potassium phosphate in the presence of HCl would result in the formation, in the first instance, of sodium chloride and lactic acid, and in the second of potassium chloride and acid sodium phosphate. In addition to this, the free HCl unites with other organic bases and nitrogenous compounds having basic properties, and especially with the albuminoids, so that it is not until material for further chemical combination with HCl is exhausted and saturation of albuminoids is complete that response occurs to tests for free HCl, and the average percentage necessary for healthy digestion is maintained. (Ewald, *Klinik der Verdauungskrankheiten*, vol. ii., 1888; Leo, *Diagnostik der Krankheiten der Verdauungsorgane*, 1890.)

[3] This is substantially Ewald's test-breakfast, which consists of 35 to 70 grammes of white bread and 300 ccm. of water, or a cup of weak tea without milk or sugar. (Ewald, *loc. cit.*)

[4] Such as Leube's or Riegel's, consisting of 400 ccm. of beef-soup, 200 grammes of beefsteak, 50 grammes of white bread, and 200 ccm. of water.

occupies from fifteen minutes to half an hour or more, the acidity of the gastric contents is feeble, and is due to lactic acid; free hydrochloric acid is not present. It is during this stage that the further saccharification of starch, which, initiated in the mouth, occurs, and continues so long as the acidity remains low and is not due to free hydrochloric acid. So soon, however, as the latter equals a few thousandths of 1 per cent., destruction of the ptyalin occurs, and starch digestion, which had begun to be inhibited as complete saturation of the proteids by hydrochloric acid took place, ceases.[1] The second stage is characterized by the complete saturation of the albuminoids by hydrochloric acid and their gradual transformation into peptones, and the presence of free hydrochloric acid in the stomach, which continues to increase until the normal limit is reached, while lactic acid diminishes or entirely disappears.

Besides the necessity for a proper secretion of hydrochloric acid as a synergist to pepsin, it has another important function which may be mentioned, and which, indeed, is regarded by some[2] as the chief—that of maintaining the ingesta in a condition of asepticity. Lactic, acetic, and butyric acids are unlikely to develop, except, of course, when already present in the ingesta as salts, when free hydrochloric acid exists in the stomach-contents. A portion of the lactic acid present in the early period of digestion probably arises from fermentation of carbohydrates through the action of the bacilli aceti lactici, which action ceases later in the presence of a small amount of free hydrochloric acid. Moreover, pathognomonic micro-organisms, such as the bacilli of enteric fever and of cholera, which may be accidentally ingested with the food, are destroyed by this acid.[3]

Normally, during fasting secretion of gastric juice probably does not occur, unless it be excited reflexly through the senses by food during hunger.[4] Examination of the secretory functions in the fasting condition has, however, given rise to some divergent results. Most observers—among which may be mentioned Riegel,[5] Ewald,[6] Jaworski,[7]

[1] Chittenden, *Med. News*, Feb. 16, 1889.

[2] G. Bunge, *Lehrbuch der Physiolog. u. Patholog. Chem.*, quoted by L. Wolff, *Med. News*, Sept. 21, 1889.

[3] Leo, *loc. cit.*

[4] Even then it may be induced in another way than by direct excitation—through swallowed saliva; for, though there is no afferent nerve the stimulation of which causes a secretion of gastric juice, there seems no doubt that secretion may be brought about through some indirect nervous channel. Thus, Richet (*loc. cit.*) noted in a case of complete occlusion of the œsophagus, in which a gastric fistula had been made for the purpose of nourishment, that sugar or lemon-juice placed in the mouth caused gastric secretion, as did also the mere smell or sight of food.

[5] *Zeitschr. f. klin. Med.*, Bd. xi. p. 11.

[6] *Loc cit.*

[7] *Wiener med. Woch.*, 1886, No. 49.

Leube,[1] Kinnicut,[2] and others—as a result of numerous examinations conclude that this function is latent during fasting, while Rosin,[3] Schreiber,[4] and others believe that even in fasting conditions a continuous secretion takes place. Thus from 44 patients examined while fasting Rosin[5] failed to obtain fluids in but 2; in 11 the fluid contained no free hydrochloric acid, while in the remaining 31 free hydrochloric acid and pepsin were found; and Schreiber, who has obtained through the expression method upward of 60 ccm. of good digestive secretion during fasting, believes that it is possible with this method always to withdraw some gastric fluid. Others, such as Pick,[6] have reported similar results, but think it likely that irritation of the gastric mucous membrane by the tube induces the secretion removed, as do also Ewald and Boas. As the mere presence of food in the mouth will produce a flow of gastric juice, which may be caused by the saliva swallowed as well as reflexly, it is not unlikely that the gastric secretions obtained during fasting, and indeed a portion of that which is withdrawn when the tube is introduced some time after a test-meal, is caused by the irritation of the tube in the mouth and pharynx, inducing a free outpouring of saliva,[7] some of which, ingested, directly stimulates an outflow of gastric juice, and perhaps reflexly through the tube in the mouth acting as did sugar and lemon-juice in Richet's case. Certainly, there can be no doubt that mere local mechanical stimulation of the gastric mucous membrane by a foreign body will induce gastric secretion.[8]

Beaumont's observations on Alexis St. Martin demonstrated this, and similar experiments have been repeated on animals with like effect. As the result of a large number of experiments on St. Martin with a view to determine the secretory condition of the stomach during fasting, Beaumont[9] almost invariably found that the stomach contained no gastric juice when aliment was not present, but that any digestible or irritating substance when applied to the internal coat excited the action of the gastric vessels, producing an outflow of fluid. On the introduction of a gum-

[1] *Deutsches Arch. f. klin. Med.*, Bd. 33, p. 3.

[2] *Med. Record*, N. Y., May 24, 1890.

[3] *Deutsche med. Wochen.*, 1888, No. 47, p. 996.

[4] *Archiv für Experiment. Pathol. und Pharmacologie*, Bd. xxiv. p. 365.

[5] *Loc. cit.*

[6] *Prager med. Woch.*, 1889, No. 18; and also Rosin, *Deutsch. med. Woch.*, 1888, No. 47; and Hoffmann, *Berl. klin. Woch.*, 1889, No. 12.

[7] The introduction of the tube until the patient becomes habituated to its use nearly always leads to free salivary secretion, much of which is involuntarily swallowed.

[8] It has been found by Blondlot and Bernard that when the gastric mucous membrane is gently tickled it becomes very rosy and secretes gastric juice freely. (Brunton *On Disorders of Digestion*, p. 172.)

[9] *Experiments and Observations on the Gastric Juice*, 1833, pp. 105, 121, 128, 135, 137, 217.

elastic tube the size of a goose-quill through the fistula into the clean fasting stomach, and placing St. Martin in such a position that the gastric orifice was dependent, a flow of juice was soon induced. It at first appeared tardily in drops, then in an interrupted, and sometimes in a short, continuous stream. Moving the tube about increased the discharge. The amount ordinarily obtained in this manner during the fasting condition varied from ½ to 2 fluidounces, and ten to fifteen minutes were necessary to collect even this small quantity. On some occasions a small quantity of mucus only could be obtained. The juice digested albuminous foods when brought into contact with them outside of the body.

Mode of Examination of the Gastric Secretions.

If it is desired to ascertain whether the secretory function is active during fasting, the stomach should be washed out on the preceding night and the tube introduced in the morning. If the amount withdrawn be upward of 50 cc.,[1] and show the presence of pepsin and hydrochloric acid, a condition of hypersecretion probably exists which, as a rule, is accompanied by a decided increase in the percentage of free hydrochloric acid normally secreted. This condition has been termed by Jaworski *gastrorrhœa acidi simplex*, and exists alone or in combination with some of the neuroses, such as melancholia or hysteria, and is now regarded as a probable cause of gastric ulcer. It also more rarely occurs with chronic gastric catarrh. When the stomach has not been washed out on the preceding night, and food-masses are removed during the fasting condition, atony of the stomach, present in acute and chronic catarrh and in gastric dilatation, is indicated. Sarcinæ, saccharomyces, and other evidences of decomposition are then present.[2]

To ascertain the secretory condition of the stomach, the gastric contents are best examined after a trial-meal. The food should be ingested, therefore, on an empty stomach, preferably in the morning, and should always be of the same quantity and character.[3] A number of examinations are usually necessary, repeated under similar conditions, before an opinion can with certainty be formed as to the secretory function of the stomach. Several varieties of test-meals are recommended: those apt to furnish the most satisfactory results are Ewald's breakfast and Leube's and Riegel's dinner.[4] The former, which is a convenient modification of

[1] Kinnicut (*loc. cit.*) states that as the question of the condition of the fasting stomach is still *sub judice*, in order to avoid any possible error he places a limit of 50 cc. of gastric juice as a basis of diagnosis of hypersecretion. Jaworski (*Wiener med. Wochenschr.*, Nos. 49–52, 1886) regards all cases as those of hypersecretion in which more than 10 cc. can be removed from the fasting stomach. [2] Leo, *loc. cit.*, p. 84.

[3] For the reason already stated, that the time of appearance of HCl depends upon the nature of the food taken.

[4] The composition of these meals is given on a preceding page.

Riegel's and Leube's test-dinner, is usually to be preferred, since its ingestion and subsequent removal are easy. While Leube's and Riegel's trial-dinner induces a freer secretion of gastric juice, it is less readily eaten, and has the additional disadvantage that in its removal particles of undigested food sometimes clog the fenestra of the tube. The stomach-contents are evacuated one hour after the test-breakfast and between the fourth and fifth hours after the trial-dinner, these intervals corresponding to the height of digestion after the meal, at which time secretion of free hydrochloric acid and pepsin should be normally at their maximum and by-products of decomposition least appreciable. On removal of the gastric contents its general appearance is noted; blood, bile, masses of mucus, and undigested food are looked for. It is then filtered into a dry beaker, and the filtrate examined qualitatively, and, if necessary, quantitatively, for free hydrochloric acid especially, and perhaps also for pepsin, rennet-ferment, albuminoids, carbohydrates, and the products of digestion—peptones and albumoses; also for phosphates, lactic acid, and the occasional fatty acids, such as acetic, butyric, valerianic, which latter are found in pathological conditions only.

A qualitative examination for free hydrochloric acid, and, *a fortiori*, for the organic acids, is indeed often all that is necessary; a rough quantitative estimate, sufficient for practical diagnostic purposes, may be made by noting the mode of response to qualitative tests. Thus, when Günzberg's reagent gives a decided rosy-red reaction with but little concentration of the gastric filtrate, it may be concluded that free hydrochloric acid is normal in amount or in excess; while, on the contrary, should but a faint or fleeting red be shown by considerable concentration of the filtrate, or should no response at all occur with Günzberg's test, yet the calcium-carbonate test show free hydrochloric acid, subacidity is indicated. Cancer and gastric atrophy may be excluded in the first instance (having in mind those exceptional cases of cancer in which hydrochloric acid is in excess) and ulcer in the latter; cases of gastric catarrh, if characterized by hyperacidity, may be differentiated, and the indications for the employment of hydrochloric acid made clear. Whatever form of examination be undertaken, it is better to precede it by a quantitative estimate of the total acidity of the gastric contents, since by it inference as to several important points may be drawn with some degree of accuracy. Thus, should the total acidity be more than 70 and the ferric-chloride color-test for lactic acid and the other tests for fatty acids indicate but a minimum of the former and little or none of the latter, the excess of acidity is evidently due to hydrochloric acid if excess of acid phosphates can be excluded.

The following method will be found convenient in the chemical

examination of the gastric contents. It is that which the writer generally pursues:

1. After filtration the reaction of the filtrate is determined.

2. A known portion, say 10 cc., is used for the estimation of total acidity.

3. A small quantity of the filtrate is tested for free acid and acid salts.

4. One or more of the qualitative tests for free hydrochloric acid are applied, preferably Günzberg's, Boas's resorcin, or the calcium-carbonate tests, following which,

5. Tests for lactic and the occasional fatty acids are made; and, subsequently, if necessary, a quantitative estimate of free hydrochloric acid and the organic acids is determined by Leo's method.

If necessary also the filtrate may be examined for pepsin and rennet, ferments, for albumoses and peptones, and finally for carbohydrates.

The reaction may be determined by litmus-paper or congo-paper or by an alcoholic solution of phenolphthalein.[1]

The absolute acidity, which is expressed by a number representing the number of cubic centimetres of test-solution required exactly to neutralize 100 ccm. of gastric filtrate, is determined by titration with a decinormal solution of sodium hydrate.[2] Ten ccm. of stomach-filtrate are placed in a clean dry porcelain or glass dish, and a few drops of phenolphthalein solution added as the most delicate indicator of beginning alkalinity. Air is first thoroughly carried through the filtrate to remove any dissolved carbonic dioxide frequently contained in the stomach-contents, and the sodium solution slowly dropped, with constant stirring, from a burette graduated to tenths of centimetres, until the liquid assumes a persistent very faint red hue. The quantity of the decinormal sodium solution used in cubic centimetres and fractions thereof is now noted; and from this the total acidity estimated by multiplying the number of cubic centimetres of sodium solution consumed by the number of times the cubic centimetres of filtrate actually used for neutralization are contained in one hundred. Thus, if 5 cubic centimetres of filtrate are taken, the number of cubic centimetres of sodium solution is multiplied by 20; if 10, by 10; if 20, by 5. One hour after Ewald's test-breakfast the total acidity should be between 20 and 60.[3] These figures indicate an acidity which if due to hydrochloric acid alone would represent 0.07 and 0.21 of that

[1] This last remains colorless in a neutral or acid medium, but develops a bright carmine hue in alkaline solutions.

[2] Four grammes of NaHO dissolved in one litre of distilled water is used for neutralization; each ccm. of this solution will exactly neutralize .00364 grammes of absolute hydrochloric acid. The number of ccm. so used multiplied by .00364 equals the percentage of HCl contained in 100 ccm. of the gastric filtrate.

[3] Leo, *loc. cit.*, p. 117. Ewald gives as the normal 40 to 65 (*loc. cit.*, p. 23).

acid. Values constantly below 20 (2 ccm. NaHO solution) would show subacidity, or constantly at or above 70 (7 ccm. NaHO solution), hyperacidity.[1]

The special significance of hyperacidity depends upon whether it arises from the presence of organic acids and acid salts or through hypersecretion of hydrochloric acid. Hyperacidity due to organic acids is of relatively frequent occurrence. It arises from abnormal decomposition of ingesta in the stomach, and is common in gastrectasia, acute and chronic gastric catarrh.

Examination for Free Acids and Acid Salts.—Since an acid reaction of the gastric contents may be due either to free acids or acid phosphates, or to both, Leo's[2] calcium-carbonate test, which permits the ready distinguishing of one from the other, is of great value. It is based on the fact that calcium carbonate in cold solution will neutralize free acids, so that an acid reaction is no longer obtainable, while it is without influence on acid phosphates, which still respond to tests for acids, reddening litmus as before. A small quantity of the stomach-filtrate is thoroughly mixed in a watch-glass with a little dry, *chemically pure* $CaCo_3$. The reaction is then taken with blue litmus-paper and compared with that of the original. Should the solution now not redden blue litmus, acid salts are absent. If the paper is reddened less intensely than at first, both acid salts and free acids are present. If the acid reaction is not markedly altered, free acids are much diminished or absent.

Leo states that by this method as small a percentage as 0.002 of free hydrochloric acid and 0.01 of lactic acid can be shown with certainty, but if a decided amount of acid phosphates is present the exactness of the test may be somewhat lessened; but even then 0.008 per cent of hydrochloric acid can be detected. After the organic acids are removed it proves the most delicate and certain test for free hydrochloric acid, as will be explained on another page.

Reagents that Respond only to Free Hydrochloric Acid.—There are two tests (Günzberg's phloroglucin-vanillin and Boas's resorcin) that respond only to free hydrochloric acid concerning the positive results of which there can be no ambiguity. They are, for this reason, decidedly preferable to the congo-red, methyl-violet, benzo-purpurine, tropaolin, and other color reagents which react more or less to organic acids, and which cannot be regarded as positive tests for the presence of hydrochloric acid unless restrictions of various sorts are practised.

Günzberg's test consists of 2 gm. phloroglucin, 1 gm. vanillin, and 30 gm. of absolute alcohol, and is applied as follows: An

[1] Leo, *loc. cit.*, p. 117.

[2] *Loc. cit.*, p. 91; and *Centrabl. f. d. med. Wissench.*, No. 26, 1889.

equal amount—one or more drops—of the stomach-filtrate and of the foregoing solution are placed together in a white porcelain dish and gently heated over a small flame, in such a way as to hold a thin layer at the bottom of the dish, avoiding scorching. After slight evaporation a delicate rose-red tinge appears at the margin of the liquid, which becomes an intense cherry-red, depositing crystals of a similar color in the presence of a decided amount of free hydrochloric acid. If but a small quantity of free hydrochloric acid is present, some condensation of the gastric filtrate may be necessary. To avoid the employment of too great heat, which might result in the development of a brown color through combustion of organic substances, and thus interfere with the delicacy of the response, evaporation on a water-bath is preferable. If but a trace of free hydrochloric acid is present, to which the test responds, the distinct red color which appears at the edge as evaporation progresses may be of only momentary duration. An approximate determination of the amount of free hydrochloric acid may be made by the test in the manner described, or preferably after the method of Günzberg, who ascertained that a drop of the normal stomach-contents could be diluted upward of ten times, and the reaction still be faintly obtained.[1] Inability to obtain a response with less dilution or with none, or even with concentration of the undiluted contents, would of course indicate sub- or anacidity, while the reaction occurring with over twelve dilutions would point to hyperacidity.[2] Boas's[3] solution consists of resublimed resorcin gm. 5, sugar gm. 3, dilute alcohol gm. 100. Its method of application is similar to that of Günzberg's test: a few drops are heated in a porcelain dish with an equal quantity of the stomach-filtrate; from a rose to a vermilion hue shows the unquestionable presence of free hydrochloric acid. Both of these tests respond with nearly the same degree of delicacy to free hydrochloric acid; any slight difference exists in favor of the phloroglucin-vanillin solution. The latter is the one the writer almost habitually employs, but in the few instances in which he has resorted to the resorcin test the results have been equally satisfactory. The response of these two tests in the manner described is a positive indication of the presence of free hydrochloric acid. But, unfortunately, both tests are less valuable from a negative point of view.

For the detection of free hydrochloric acid in watery solutions these tests leave little to be desired on the score of delicacy, but, unluckily,

[1] *Centralbl. f. klin. Med.*, 1887, No, 40; Ewald, *loc. cit.*, p. 24; Leo, *loc. cit.*, p. 96.

[2] Dr. Max Einhorn, the deviser of the ingenious silver bucket for obtaining small amounts of the stomach-contents without resort to the tube, informs me that as a result of considerable investigation he concludes that normally the response cannot be obtained after eight dilutions. He has found by titration that eight dilutions equal pretty nearly the normal acidity (50 to 60).

[3] *Centralbl. f. klin. Med.*, Bd. ix. p. 817, and Leo, *loc. cit.*, p. 97.

the same conditions do not hold in the presence of some of the most common constituents of the gastric contents during digestion. Thus, in watery solutions .004 per cent. of hydrochloric acid may be detected by the Günzberg test, and .006 by Boas's resorcin test, while in the presence of certain compounds, such as 2 per cent. peptone solution, as much as 0.15 per cent. of free hydrochloric acid may not respond to either. Notwithstanding this, the reaction obtained with these tests affords undoubted evidence of the presence of free hydrochloric acid, and, being so easy of application, one or the other should always first be tried when a mere qualitative examination is made: a negative response resulting, hydrochloric acid cannot be pronounced absent until the $CaCo_3$ test also fails. The latter is the only one of the several tests the reaction of which is uninfluenced by the presence of other combinations in the stomach. Large amounts of acid phosphate alone interfere very slightly with its delicacy, it being then somewhat difficult to make an accurate comparison between litmus reddened by the presence of but a trace of free hydrochloric acid and decided amounts of acid phosphates, and that reddened by the phosphates alone. Despite this, as small a percentage of free hydrochloric acid as 0.008 may be detected by the $CaCo_3$ test in the presence of acid phosphates.[1]

The calcium-carbonate test is applied in the manner directed for ascertaining the presence of free acids and acid salts. Lactic acid having been removed by agitation with ether and the fatty acids by heat, a piece of blue litmus-paper is moistened with the solution, and the red tint produced compared with that obtained by moistening a second piece with the stomach-filtrate after neutralization of the free acid by dry C. P. calcium carbonate.[2]

Examination for Organic Acids.—Lactic acid may be detected by a modification of Uffelmann's carbolated ferric-chloride test.[3]

[1] Leo (*loc. cit.*, p. 98, *et seq.*), who has carefully investigated this subject, has shown that all color reagents for free hydrochloric acid are more or less influenced in delicacy of response by the presence of various substances occurring in the stomach during digestion—the ingesta and the products of their metamorphosis. This influence is unfortunately most marked with Günzberg's and the resorcin test, which in other respects are so superior. This interference is occasioned by a portion of the free HCl uniting with and suffering neutralization by the ingesta.

[2] The digestive test suggested by Leo (*loc. cit.*, p. 98) for the presence of free hydrochloric acid is scarcely practicable. It may, however, at lest be mentioned here. It is based upon the fact that free hydrochloric acid is necessary for pepsin digestion, at least in the absence of very large amounts of the organic acids. The presence of the latter being excluded and digestion of albuminoids proved, it may be accepted that the stomach still secretes hydrochloric aid. Leo recommends a test-meal consisting of a measured amount of albuminoids, such as a half litre of milk or two eggs, which is to be removed one hour after its ingestion and the amount of albumoses and peptone now contained in it compared with the same in the food before its ingestion.

[3] Uffelmann's original test for lactic acid of carbolated ferric-chloride is very unreliable, since it responds also to glucose and acid phosphates.

An aqueous solution of ferric chloride so dilute as to be almost colorless is placed in a test-tube and a few drops of the gastric filtrate added; the faint yellow color of the iron solution, while not affected by the addition of hydrochloric, butyric, or acetic acid, is intensified in presence of dilute lactic acid.[1] To avoid the possibility of error, Kinnicut[2] advises comparing the tube containing the tested filtrate with a second of the original iron solution. Thus used, the writer has found the test very satisfactory, though, according to Leo,[3] it, like the carbolated ferric-chloride test, reacts also to peptones and the lactates. To obviate all such sources of fallacy, Leo advises the removal of the fatty acids by heat,[4] the extraction of lactic acid by ether, and the testing of an aqueous solution of the ethereal extract by Uffelmann's reagent and with calcium carbonate (or congo-red solution).

The fatty acids which appear in certain gastric derangements, such as dilatation, acute gastric catarrh, and less often in chronic gastric catarrh and gastric atrophy, arise through decomposition of the ingesta, chiefly because of a deficient secretion of hydrochloric acid,[5] and may be readily detected in the following manner: A few ccm. of the gastric filtrate are heated in a test-tube, a piece of blue litmus-paper moistened in water being held over the mouth of the tube; as the fatty acids alone are volatile, minute traces of these are so detected.[6]

Examination for Pepsin and Rennet Ferment.—The presence of pepsin is shown by the ability of the gastric filtrate to digest albumin. A small portion of purified blood-fibrin[7] is placed in 10 to 20 ccm. of the gastric filtrate, and the whole maintained at a temperature of about 40° C. on a water-bath or in a warm chamber for several hours until the fibrin is dissolved. If the tests have shown the absence of hydrochloric acid or much diminished acidity, it will be necessary to add a small quantity of hydrochloric acid. If after some

[1] V. Jaksch, p. 103. [2] *Loc. cit.*

[3] Leo, *op. cit.*, p. 106.

[4] Heat must be applied so long as moist blue litmus-paper held over the test-tube is even slightly changed in color.

[5] But see Roberts, *loc. cit.* Small quantities of these acids may be derived from foods containing them in the form of salts. Milk, butter, and cheese all contain more or less butyric acid existing free or combined. The butyrates are decomposed by hydrochloric acid.

[6] The scope of this work forbids the writer discussing in more than bare outline the qualitative application of these important tests, and quantitative methods cannot be considered. It may be stated that the least difficult of employment of the *reliable* quantitative tests for hydrochloric acid and the organic acids is that of Leo, fully described in his recently-published work, *Diagnostik der Krankheiten der Verdauungsorgane.*

[7] Blood-fibrin is preferable to egg-albumin. It is prepared for use by repeated washing in water until all discoloration by blood is removed, and is then preserved in glycerin. Before using a small piece is taken and again thoroughly washed to remove the glycerin.

hours the fibrin remains undissolved and develops an odor of putridity, pepsin is evidently absent.

The rennet ferment is readily detected by the addition of a few drops of the stomach-filtrate to a small quantity of unboiled milk, and placed in a warm chamber or on a water-bath at 40° C. A coagulum forms after the lapse of a few minutes or hours, surrounded by a clear whey if the ferment is present.[1]

The Motor Function of the Stomach.

Those movements of the stomach[2] by which the ingesta are intimately mingled with the gastric secretion, their solution promoted, and after digestion their absorption or gradual passage through the pylorus effected, may be diminished, constituting atony or motor weakness, frequently present in gastrectasia, acute and chronic gastric catarrh, and in some gastric neuroses; or they may be increased in degree, thereby inducing a too rapid passage of the only partly dissolved ingesta into the duodenum.

The propulsive action of the stomach is regarded by some as its chief function. Its diminution is considered by others, notably Klemperer,[3] as often the first symptom of gastric derangement, which later is followed by alteration in the secretory and other functions. As suggested by Kinnicut,[4] its estimation is not only of diagnostic value, but also of therapeutic and prognostic importance. Thus in cases of hypersecretion the preservation of motor efficiency implies the absence of

[1] Should no coagulum occur in this way, it may be presumed that rennet ferment is absent, though its antecedent, lab-zymogen, may not be. The latter may be shown by the addition of 2 ccm. of concentrated $CaCl_2$ to the above mixture, and by placing the latter in a warm chamber as before. Coagulation, now occurring, indicates the presence of zymogen, which, through the action of hydrochloric acid generated by the addition of $CaCl_2$, is transformed into the rennet ferment.

[2] By a species of periodical rotation on its long axis, with walls contracted about the ingesta and orifices closed, the stomach effects the solution of food-masses and their permeation by the gastric secretion. By peristalsis the dissolved portions are passed from the fundus toward and finally through the pylorus. The necessity of these movements for efficient digestion can be readily shown outside the body by artificial digestion. Continued slight agitation of the vessel containing the digestive fluid and the albuminoid effects a much more ready solution of the latter, both by intimately commingling the two and by separating the peptone formed from the yet indigestible albumin.

In the glass beaker, as in the stomach, an accumulation of peptones is an obstacle to continued digestion. The gastric movements not only aid in removing the peptones formed on the periphery of the bolus, so that the digestion of its interior may be continued, but also, in Leube's opinion ("Diseases of the Stomach and Intestines," *Ziemssen's Cyclop. of Medicine*, vol. vii.), assist in the absorption of peptones by rendering the lymph- and blood-current more active.

[3] *Verhandlungen des Congresses für Innere Medicin.*, vii. Congress, Wiesbaden, April, 1889.

[4] *Loc. cit.*

ectasia, rendering the diagnosis more favorable. In gastric cancer, with diminution in or absence of the secretory function, with preserved motility, fair nutrition may still be maintained for a time by means of intestinal digestion. An estimate of the motor function may be made by several methods. That formerly in use (Leube's)[1] consisted in the introduction of the tube seven hours after a meal of soup, beefsteak, bread, and water, and the removal of what remained by washing out the stomach. Reduction of the motor action is shown by the wash-water containing portions of the ingesta, the amount varying directly with the severity of the muscular abnormality; all of the meal before the expiration of seven hours should have passed into the duodenum. This method, though useful in the detection of decided cases of atony and dilatation, is of less value in the recognition of medium degrees of the same. Leo[2] regards it of the greatest utility in the diagnosis of hypermotility. Thus if the stomach is found to be empty three hours after Leube's test-dinner and one and a half hours after Ewald's test-breakfast, this diagnosis may be made with certainty. The method with salol, originated by Ewald[3] and Sievers, consisting in the administration of 15 grains in wafer soon after a meal, was based on the fact that this drug, which escapes decomposition and absorption in the stomach, is split up by the alkaline juices of the intestines into its components, salicylic and carbolic acids, which are converted into salts absorbed and excreted by the kidneys, salicylic acid appearing in the urine as salicyluric, and may be detected in that fluid by suitable tests[4] in from one-half to one hour after its ingestion in cases of gastric euperistalsis, but not until a very much longer time in cases of lessened motility. Unfortunately for the accuracy of this test, so used, later experimentation by Rodcyjewski,[5] Brunner,[6] Huber,[7] Leo,[8] and others has shown that with presumably normal motility the intervals may vary considerably between the appearance of salicyluric acid in the urine and the ingestion of salol, two hours frequently elapsing before its detection.[9] Huber regards the time of disappearance of the salicyluric-acid

[1] *Deutsches Arch. f. klin. Med.*, Bd. 33, p. 8. [2] *Op. cit.*, p. 79.

[3] *Op. cit.*, p. 44, and also *Therapeut. Monatshefte*, 1887, No. 8.

[4] Solution of ferric chloride is added to the urine drop by drop. A violet color is developed should salicyluric acid be present. It may be detected in smaller amounts, and hence earlier, by acidulating the urine with HCl, agitating with ether, and subsequently testing the ethereal extract with iron-chloride solution.

[5] *Maly's Jahresbericht*, 1889, p. 196. [6] *Deutsche med. Woch.*, 1889, No. 7.

[7] *Münch. med. Woch.*, 1889, No. 19; *Centralbl. f. klin. Med.*, 1889, p. 803.

[8] *Loc. cit.*

[9] An interesting experiment, showing the influence of diet on the time of the appearance of salicyluric acid in the urine, and its probable cause, is described by Bourget (*Revue méd. de la Suisse Romande*, No. 12, 1888, quoted by Henry, "Diagnosis and Treatment of Functional Stomach Disorders," *Transactions Phila. Co. Med. Soc.*, vol. x., 1889), who found that after a simple meal of meat and a glass of water containing 2 per

reaction in the urine as a more certain test of the motor efficiency of the stomach, and proposes a modification of the salol test based on the fact that in healthy persons 1 gramme of salol taken after dinner will continue to show its presence in the urine for upward of twenty-four hours. But in cases of diminished gastric motility the reaction may still be obtained for from thirty-three to forty-eight hours.

To render the results as trustworthy and comparable as possible, a similar meal should be used in all cases in which the salol test is tried —one moderately easy of digestion and unlikely to originate an undue amount of acid or alkali. Recalling Bourget's results and their probable explanation, it is likely that in cases of hyperacidity, more especially when due to excessive secretion of hydrochloric acid, the salicylic reaction would be delayed somewhat without motor inefficiency existing. If the above precaution is observed and the latter point borne in mind, conclusions that can in the main be depended upon will be obtained.

The writer has found the salol test of considerable utility as a gauge of gastric motility by employing both Ewald and Brunner's methods at the same time. The patient is supplied with the ferric-chloride solution, and directed to examine a small quantity of urine at the expiration of half an hour after dinner and the ingestion of the salol, and to repeat the examination every fifteen minutes until response occurs. The duration of the interval is then noted, and the urine not again tested until the end of twenty-four hours from the time of taking the salol. Should a response still occur, the urine is tested at intervals of two or more hours until this ceases. If the response both occurs and disappears early, it is concluded that the motor function of the stomach is normal or in excess.

The method of Klemperer,[1] more recent than that of Leube or of Ewald and Sievers, though much less practicable, consists in the introduction by the tube of 100 grammes of olive oil into the empty stomach, and withdrawing what remains after two hours.[2] As oil is not

cent. of HCl the urine responded to the test for salicylic acid in from one and a quarter to one and a half hours, while after a meal of fruit, meat, and vegetables salicyluric acid could be detected in from fifteen to twenty minutes. The reaction of the fluid in the first part of the duodenum depends largely upon the quantity of acid poured into it from the stomach. If to the already acid gastric juice an additional quantity of HCl is added, neutralization of the alkaline fluid in the duodenum will result, and a considerable stretch of intestine may have to be traversed by the salol before sufficient alkalinity is present to decompose it. Conversely, by increasing the alkalinity of the intestinal juices, as may be effected by the ingestion of fruit, the organic acids of which are decomposed into alkaline products, the chyme will be entirely neutralized in the first part of the intestine, and the salol speedily split up.

[1] *Deutsch. med. Woch.*, No. 47, 1888.

[2] The oil should be removed by aspirating with water. It is then separated from the water, the remaining oil taken up with ether, and the ethereal solution placed in

absorbed from the stomach, the difference between the amount introduced and that withdrawn indicates the condition of gastric peristalsis. Klemperer ascertained by numerous experiments that normally from 70 to 80 gm. of oil are passed into the duodenum in two hours.

The Absorbent Function of the Stomach.—The condition of this is best ascertained by Penzoldt[1] and Faber's method: 2 or 3 grains of potassium iodide enclosed in a gelatin capsule, which is well wiped to remove all trace of the salt from its exterior, are ingested with a wineglassful of water on an empty stomach. The salt is absorbed from the stomach, and appears normally in the saliva in from six and a half to fifteen minutes. In diseased conditions in which absorption is tardy, such as gastric catarrh, dilatation, and cancer, the saliva may not contain it for several hours. It is recognized by the patient moistening with the saliva filter-paper which has first been saturated with starch paste and dried. A drop of fuming nitric acid is applied to the moistened spot, and if iodine is present a bluish discoloration is rapidly developed.

ACUTE GASTRIC CATARRH, ACUTE INDIGESTION, SIMPLE ACUTE GASTRITIS, INFLAMMATORY DYSPEPSIA.

THE term "acute gastric catarrh" practically includes all forms of acute or subacute gastric disturbance indicated in the title of this section. It is dependent upon somewhat varied etiological factors, a special knowledge of the most direct of which is important from a therapeutic point of view. These are—a too free indulgence in the pleasures of the table, the ingestion of food or drink of irritating quality or an excessive quantity, and the use of indigestible aliment. The former includes very hot, cold, or indigestible food, spices, undiluted spirituous beverages, and certain drugs,[2] all of which probably originate acute catarrh through their local irritant action on the gastric mucous membrane.[3]

a bulb the weight of which is known. The weight of the oil is calculated after abstraction of the ether.

[1] *Berl. klin. Woch.*, 1872, No. 21.

[2] The drastic cathartics, for instance. The various corrosive poisons, such as oxalic acid, the mineral acids, salts of mercury, arsenious acid, lead, and others which cause toxic gastritis through actual destruction of tissue, are not now considered. Other drugs, such as opium, belladonna, chloral, the bromides, and the like, may predispose to gastritis through their local or indirect effect on the gastric functions.

[3] Increased acidity toward the end of gastric digestion is supposed by Brücke (*Lehrbuch der Physiol.*, 4 Aufl. Bd. i. p. 322) to excite reflexly, through slight irritation of the stomach-walls, the muscular movements leading to expulsion of the chyme into the duodenum. Anæmic conditions predispose to acute catarrh largely through

Excessive indulgence in food of proper quality induces gastric catarrh more indirectly. Secretion of gastric juice being inadequate for its thorough digestion, it remains an abnormally long time in the stomach,[1] and, besides irritating that viscus mechanically, it undergoes fermentation, as a result of which, through the action of micro-organisms, secondary chemical products develop which are irritating to the mucous membrane.

These factors are of course operative to a far greater degree in the debilitated and in febrile and anæmic conditions, when diminution in the secretion of gastric juice and impairment of motility are present, and lead to fermentative processes in the stomach. Then acute gastric catarrh may seem to arise spontaneously, though actually it is originated through impaired secretory and motor power.

The chief therapeutic indications in the management of acute gastric catarrh are removal of the exciting cause, allaying gastric irritability, and so resting the inflamed organ that it will return to its normal condition in as short a time as possible. Anorexia and certain local symptoms are often efficient in meeting the first indication without the physician's aid. Loss of appetite checks further excess in eating, and undigested aliment in the stomach, the more direct determining cause of the attack, is frequently removed by spontaneous vomiting, without a resort to emetics or the stomach-tube. In all cases arising through indulgence of the appetite beyond the digestive capacity of the stomach, stagnation of the ingesta occurs in this viscus through lack of secretion of gastric juice for their solution, and loss of sufficient motor tone to cause their onward passage through the pylorus.

The presence of undigested aliment is usually shown by epigastric uneasiness, fulness, and pain, belching of foul-smelling gases, nausea, and vomiting, and, though no food has been taken for more than forty-eight hours, unprovoked or induced emesis may lead to the expulsion of large quantities of partially-dissolved decomposing masses. With the above symptoms, should spontaneous emptying of the stomach not occur, vomiting may be induced simply and easily, if a condition of marked atony or dilatation be not present, by the ingestion of a pint or two of warm water containing a tea-spoonful each of sodium bicarbonate

diminution in the secretion of HCl. Insufficient secretion of gastric acid also probably induces catarrh through permitting septic processes to occur in the stomach which normally are inhibited by the presence of free HCl.

[1] A meal excessive in quantity and of substances inherently difficult of solution acts as an irritant to the gastric mucosa, as did the glass rod in the hands of Bernard on the dog's stomach. When the irritation was carried beyond gentle tickling, secretion of gastric juice and the rosy-red hue developed by a slight grazing of the surface disappeared, displaced by pallor, suppression of the secretion of gastric juice, and the formation of ropy mucus. It is suggested by Brunton (*Disorders of Digestion*) that similar changes take place in the stomach under the influence of undigested aliment, thus causing attacks of acute indigestion or gastric catarrh.

and table salt, followed by titillation of the fauces with the finger or a feather. Vomiting not being excited in this manner, or, after emesis, a continuance of the local symptoms indicating that the stomach has not been efficiently emptied, a resort should be had to the soft stomach-tube or an unirritating emetic. Though the tube is much preferable to the latter, it is often difficult to obtain the patient's consent to its introduction, its use appearing to one unaccustomed to its application sufficiently formidable to cause an emetic to be preferred. The advantages of the tube are that the stomach can be completely evacuated with trifling inconvenience to the patient and with but slight gastric disturbance, and that a thorough cleansing of its mucous membrane can afterward be effected,[1] promoting a far more prompt return to the normal than by the use of an emetic, which, however unirritating in its local action, may temporarily further derange the stomach, and perhaps induce a continuance of gastric irritability, which otherwise might have subsided after complete emptying of that viscus. Should, however, an emetic seem more expedient than the tube, one that acts rather by virtue of its systemic[2] effect than by local operation is to be preferred, and of the former apomorphine and ipecac should alone be used. Tartar emetic, much formerly resorted to, is now rarely employed, because of its highly irritating local action and the systemic depression it induces. Apomorphine is preferable to ipecac, since it may be administerd hypodermically—it being often desirable to employ that method of inducing emesis—and since but little nausea follows its introduction by the mouth or subcutaneously. It usually acts promptly in doses of $\frac{1}{16}$ to $\frac{1}{12}$ of a grain hypodermically, and from $\frac{1}{12}$ to $\frac{1}{8}$ grain by the mouth. Ipecac in doses of from 1 to 5 grains, administered in a wafer and repeated at intervals of half an hour until emesis occurs, induces vomiting in from fifteen to thirty minutes. Drinking warm water freely promotes its action.

Subsequent to the evacuation of the stomach-contents, or in place of this in cases in which the former seems unnecessary, an unirritating laxative should be administered if constipation, as is usually the case, be present. Effervescing salines may be employed, such as a Seidlitz powder, magnesium citrate, or other saline laxative combinations that are sold in the shops, or preferably calomel, succeeded in eight or ten hours by a saline should sufficient purgation not be induced by the latter alone. The experiments of Beaumont on St.

[1] For description of the method see Lavage in the treatment of gastrectasis.

[2] Probably all so-called systemic emetics introduced into the circulation through other channels than the stomach cause emesis by their local (reflex) effect, as well as through their direct action on the vomiting centre in the medulla, by their excretion from the blood into the stomach. It is certain that tartar emetic and ipecac do: the former causes gastro-intestinal irritation, however introduced. Apomorphine in the dose indicated is without injurious effect on the gastric mucous membrane.

Martin indicate that calomel has an influence little short of specific on the mucous membrane inflamed through dietetic errors. Morbid conditions of St. Martin's stomach, such as generalized erythematous, aphthoid, and ulcerated patches, associated with secretion of ropy mucus and even muco-pus, at times blood-tinged, a diffused thickening of the mucous membrane, with much vitiated gastric secretion, so frequently found to a greater or less degree as a result of too free indulgence in ardent spirits or from dietetic errors, seemed to be rapidly dissipated under the influence of full doses of calomel, either dusted upon the mucous membrane or administered in pill form. It is difficult to determine how much of this action of calomel in removing the morbid condition of the mucous membrane underlying an attack of gastric catarrh is local, due to its sedative and antiseptic effects, and how much remote through its cholagogue action. The latter is perhaps its chief, though not its entire, effect. Indiscretions in eating and drinking originate acute gastric disturbance and produce also an obstructed flow through the hepatic capillaries, inducing portal stasis through the conveyance of products of imperfect digestion and of decomposition from the gastro-intestinal mucous membrane to the liver.[1] Such venous engorgement will interfere with gastric and intestinal digestion, and this again reacts on the liver, inducing thus a vicious circle.[2] By a removal of these irritating products and a depletion of the liver, which calomel will effect, the circle is broken.

Believing that it is well to endeavor to obtain both the local and the cholagogue action of calomel, the writer is in the habit of prescribing it in trituration with sodium bicarbonate in doses of from 2 to 5 grains of the former to 5 or 10 of the latter. Sodium bicarbonate incorporated with it assists in the solution of the alkaline mucus, and enables the calomel to come into more intimate relation with the mucosa.

Following evacuation of the contents of the stomach, gastric irritability, should it continue—as it probably will, due as it is to an inflamed condition of the mucous membrane—is best allayed by the total withdrawal of all food for a limited time, confining the patient to bed, the application of counter-irritants in the form of sinapisms or a small blister to the epigastrium, and the administration of a few drops of dilute hydrocyanic acid with 5 to 10 grains of bismuth subnitrate rubbed up with glycerin or mucilage of acacia and exhibited in mint-water. Hydrocyanic acid has a remarkable sedative effect on the mucous membrane of the stomach. It is difficult to conjecture how the insoluble bismuth salts act, but they certainly enhance the efficacy of the other. Bismuth is frequently combined with carbolic acid, which also has decided sedative effects. The writer has frequently used this

[1] Brunton, *op. cit.*, p. 25, *et seq.*

[2] *Ibid.*, p. 26.

combination, essentially that suggested by Bartholow, with the happiest results:

℞. Acidi carbolici, gr. ¼;
Bismuth. subnitratis, gr. x;
Mucilaginis acaciæ, ♏xx–xxx;
Aquæ menthæ piperitæ, q. s. ad ʒij.—M.
Sig. To be taken in a table-spoonful of water every one, two, or three hours.

Brunton[1] recommends the combination of potassium bromide with bismuth and hydrocyanic acid, because of its well-known effects in inhibiting reflex action, that of vomiting among others. His formula is—

℞. Bismuth. subnitratis, gr. x;
Potassii bromidi, gr. xv–xx;
Acidi hydrocyanici diluti, ♏v;
Spirit. chloroformi, ♏x;
Mucilaginis acaciæ, fʒij;
Aquæ, q. s. ad fʒj.—M.
Sig. To be taken every three or four hours about ten minutes before food.

It is, however, probable that this combination would be more efficient without the bromide, which, though of service in cerebral vomiting, through its power, possessed also by morphine and chloral, to lower the irritability of the vomiting centre in the medulla, is little likely to be of avail in that originated by an inflamed condition of the gastric mucosa.

Morphine by the mouth, rectum, or subcutaneously is advised for the purpose of allaying gastric irritability, but in my experience it is usually badly borne, and tends later rather to aggravate than to ameliorate the trouble, probably largely through its provoking diminution of the gastro-intestinal and the hepatic secretions and increasing portal stasis.

[1] Brunton recommends in connection with the above formula the postural treatment for vomiting. A tendency to vomit is often increased by lying on the right side. Budge (*Die Lehre von Erbrechen.*, p. 66) has attributed this to the greater pressure exerted by the liver upon the stomach in the position. Brunton, however, thinks the benefit derived from the sinestral position more likely due to the absence of any dragging on the stomach and the irritation it would cause, rather than to any change in the relations of the liver. He states that "the mere weight of the stomach itself and its contents will exert a drag upon it directed more or less toward its pyloric end, either in the sitting posture or when recumbent on the right side. The stomach is much more sensitive to any force exerted in this direction than to one toward the cardia, even in the normal condition, and it is likely to be still more so when rendered hyperæsthetic by inflammation."

The ingestion at frequent intervals of bits of ice or small quantities of iced carbonated water, such as Vichy, Seltzer, or Apollinaris, allays thirst and tends also to check nausea and vomiting.

The occurrence of acid and bad-smelling eructations demands the administration of an alkali, magnesia, chalk, or preferably sodium bicarbonate, combined with mild antifermentatives, such as bismuth salicylate and pulverized charcoal. The latter, though theoretically useless, since in the moist state its power to absorb gases is *nil*, actually is of decided benefit in allaying flatulence.[1] Sodium bicarbonate (or other antacid) must not, however, be used in too full doses or for too long a period in this disease, as it will not only neutralize acids arising through fermentation, but its use will tend to maintain the condition we are endeavoring to obviate by uniting with the natural gastric acid when the secretion of the latter becomes re-established, thus permitting fermentative processes to continue.

The pathological condition underlying acute gastric catarrh, as examplified in the case of St. Martin, indicates the necessity of putting the stomach in a state of complete physiological rest for as long a period as possible. With symptoms almost too slight to attract attention to the stomach, Beaumont observed patches of congestion and abrasion of the gastric mucosa, the presence of thick mucus and muco-pus, and a diminished secretion of gastric juice : with such a condition of affairs digestion was delayed from two to two and a half hours.

With preserved appetite and subjective and objective symptoms of mild catarrhal gastritis arising from gluttony or over-indulgence in alcohol, the pathological condition existed referred to on a preceding page; the gastric secretion consisted of bile and bloodstained, ropy mucus and muco-pus of a peculiarly fœtid and disagreeable flavor, without perceptible acidity.

Microscopical examination of the stomach of animals in which Ebstein artificially produced an acute gastric catarrh by the administration of alcohol, and in which the macroscopic alterations were of the character noted by Beaumont in St. Martin's case, showed also cloudiness, shrinking, and occasionally fatty degeneration of the gastric tubules. With such pathological changes, indicating for the time more or less complete suspension of the functional activity of the stomach, the latter is in no condition to functionate,[2] and nourishment must consist of such

[1] Brunton (*op. cit.*, pp. 68 and 215) suggests the plausible explanation of the efficiency of charcoal in checking flatus that it acts as a mechanical stimulant, its use in the stomach being similar to that of tooth-powder in the mouth. The small mechanical particles, brought into contact with the coating of mucus covering the lining membrane of the stomach in gastric catarrh, tend to remove it, and at the same time the friction they exert on the mucous membrane will also tend to increase the flow of blood through the vessels, stimulating them to absorption of gases.

[2] In all decided cases of acute gastritis secretion of HCl is much diminished or for

aliment as will undergo digestion in the duodenum, or feeding had better be done through the rectum. If the patient is well nourished and the attack has arisen through indiscretion in diet, with decided gastric irritability present, complete abstinence from food for twenty-four to thirty-six hours is indicated. Should the feelings of the patient or of his friends be against this, and it seem desirable that a certain amount of nourishment be given, and the stomach be in a condition to retain aliment, milk, containing sodium bicarbonate and common salt[1] or a carbonated alkaline water, may be administered in small quantities at frequent intervals.[2] Should milk thus administered not be well borne, peptonized milk,[3] peptonized milk-gruel,[4] or beaten-up eggs[5] may be tried. If more concentrated nourishment be indicated, a peptonized meat—preferably Mosquera's beef-meal or Mosquera's peptone-jelly—may be used. If the exigencies of the case demand rectal feeding, which should not be resorted to in gastric catarrh unless absolutely necessary, since it is always disagreeable

a time absent. Lactic and fatty acids, the products of decomposition, are present. The motor function is always diminished.

[1] Ten grains to each 8 ounces of milk.

[2] Roberts (*Digestion and Diet*, p. 181) calls attention to the fact that in the seriously sick with an almost paralyzed stomach milk is not acted upon in that viscus. "There is neither pepsin nor acid to curdle it, and it passes as a flowing liquid into the duodenum. Arriving there, it encounters the secretion of the still-active pancreas, and milk is especially amenable to the action of the pancreatic juice."

[3] Peptonized milk is very simply prepared by pouring a pint of milk and a gill of water into a clean quart vessel, and a tube of Fairchild's powder (containing 5 grains of pancreatic extract and 15 of sodium bicarbonate), or the same quantity of soda and 1 to 2 drachms of an active solution of the pancreas (of which the best in this country seems to be that made by Parke, Davis & Co.). The vessel is well shaken, and placed in warm water for half an hour or longer until a faintly bitter taste develops. It is then boiled for two or three minutes to check further action of the ferment, iced, and administered alone or preferably with carbonated water, which disguises the slight bitterness effectually.

[4] Peptonized milk-gruel is prepared by the addition of a measured quantity of hot thick gruel, made from wheaten flour, oatmeal, sago, pearl-barley, etc., to an equal amount of cold milk. This mixture will have a temperature of about 125° F. To each pint of this pancreatin and soda are added, as in the peptonization of plain milk. It is then set in a warm place for two or three hours, raised to the boiling-point, and strained. The bitterness of the digested milk is almost completely masked in the milk-gruel so prepared.

[5] These, in the more pronounced cases of acute catarrhal gastritis in which the stomach is unable to digest solid food, pass from that viscus into the duodenum unchanged, and are slowly digested in their transit down the intestine (Roberts, *op. cit.*, p. 186). A whole egg or its yelk may be whipped up with boiling water, strained, and added to a little light broth or clear soup (consommé). (See Yeo's article in Volume I. of this SYSTEM.) Or the white of several eggs may be thoroughly beaten and allowed to settle. A table-spoonful of this precipitate, added to 3 or 4 of sterilized water containing a little crushed ice and sweetened with sugar, glycerin, or saccharin, may be taken at intervals of two or three hours. A half tea-spoonful of brandy added to this improves the flavor, but would be inadmissible in the affection under consideration.

to the patient, such aliment should alone be used as is most readily absorbed from the bowel.[1] Preceding each nutrient enema the rectum should be emptied and cleansed with warm water.

During convalescence a general diet should be very gradually returned to. A small quantity of easily-digested solid aliment is first added to the liquid,[2] peptonized if desired, and later a more generous albuminous diet, such as stewed chicken, boiled mutton, and broiled tenderloin of steak, is allowed, each meal being succeeded at the expiration of half an hour by one or more doses of 10 to 15 drops of dilute hydrochloric acid, since deficient secretion of the gastric acid is apt to persist for some time after convalescence has been established. Too great care cannot be exercised to avoid the development of chronic gastritis or a condition of atonic dilatation.

Acute gastric catarrh, when due, as it occasionally is, to rapid changes of temperature causing a sudden chilling of the body after it has been overheated, is managed in much the same manner. The first indication, however, is a diversion of blood to the surface, which may be induced by the employment of pilocarpine hypodermically or the administration of a hot bath; subsequent chilling of the surface must be avoided by packing between blankets until the external body-temperature is lowered gradually to the normal. Free perspiration thus brought about will frequently rapidly jugulate a gastritis so arising, without resort to other measures.

Toxic Gastritis.—The management of toxic gastritis occurring in consequence of the ingestion of such corrosive substances as the mineral, carbolic, and oxalic acids, alkalies, phosphorus, arsenic, and other irritants which exert a corrosive action on the mucous membrane, resolves itself into the neutralization and removal of the irritant poison, the administration of demulcents to counteract its irritant local effect, supporting the powers of life until the dangerous period is past, and, finally, treating the resulting gastritis by the methods already indicated.

The corrosive substance swallowed is neutralized by its appropriate antidote. For acids a mixture of calcium, magnesia, and water may be used. This forms, with all the acids except oxalic, soluble harmless salts. If magnesia is not at hand, solutions of sodium carbonate, chalk, or soap should be administered. Ingestion of the caustic alkalies demands the employment of diluted acetic acid, vinegar, lemon-juice, tartaric acid; carbolic acid calls for soluble sulphates, or calcium hydrate or saccharate. Poisoning by phosphorus necessitates the use of sulphate of copper or the old, unrectified oil of turpentine, while the ingestion of arsenic calls for the hydrated sesquioxide of iron or magnesium

[1] See Rectal Feeding in Gastric Ulcer.

[2] The yelk of egg, fragments of stale bread or toast, pounded beef or chicken to broths or clear soup. (Yeo, Volume I. this SYSTEM.)

sulphate. Mucilages and oils are administered as demulcents after neutralization and evacuation of the alkalies and mineral acids.

In all cases of poisoning, unless due to corrosive or mineral acids, the stomach should be emptied and thoroughly washed out by the use of the stomach-pump or soft tube rather than by emetics. If neither the soft tube nor the stomach-pump is at hand, Ewald[1] suggests the employment of a piece of ordinary rubber (gas) tubing, to the distal extremity of which, in lieu of a funnel should the latter also not be procurable, the neck of a medicine-bottle may be attached, the bottom having been first removed.

CHRONIC GASTRIC CATARRH AND ATROPHY OF THE GASTRIC TUBULES.

BEFORE considering the therapeutics of chronic gastric catarrh it is essential to have a definite understanding of what this term indicates. There has existed in no other branch of medicine a more utterly misleading classification of diseases than that adopted for those affecting the stomach. This is perhaps largely due to the fact that so-called dyspepsia, when not symptomatic, originated by a structural lesion, rarely shortens life, so that opportunity of comparing the complexus of symptoms with the *intra-vitam* pathological alterations observed after death have been few, and the character of these alterations have also been obscured by the early post-mortem changes which occur in the stomach-walls.

The terms dyspepsia, apepsia, bradypepsia, gastric atony, chronic indigestion, and the like have been and are still used by some interchangeably with the term gastric catarrh, entirely without regard to what may be the pathological condition underlying the symptoms. In Germany, with the teaching of the stomach-tube to compare with the results of clinical observation as a basis of diagnosis, a more correct nomenclature of gastric ailments, founded on pathological conditions as well as anatomical seat, has been formulated. Through the influence of German writers in this field we no longer diagnosticate "dyspepsia," employing the term to represent a morbid entity. Such ambiguous titles as apepsia, irritable, atonic dyspepsia, chronic indigestion, and others similar, indicative as they are of mere symptomatic conditions if they are not loosely used as synonyms of gastritis, are now employed to represent functional morbid states of the stomach induced and perpetuated by a disturbance of its nervous mechanism.[2] A correct

[1] *Klinik der Verdaunungskrankheiten*, vol. ii. p. 275, 1888.

[2] *Vide* Ewald, *op. cit.*, p. 277.

understanding of this is absolutely essential for a successful therapy in gastric disorders.

With neuroses of the stomach, however, it is not the writer's province to deal. He can here scarcely do more than advise due caution in arriving at a diagnosis of chronic gastric catarrh where the possibility of a neurosis underlying the symptoms is in question, since the management of the former is entirely different from that of the latter; but if a wide difference exists in the treatment of the two conditions, the symptomatology of each is also so divergent—except perhaps in nervous anacidity and suppressed secretion due to atrophy of the tubules—that it requires no great power of discernment to distinguish the functional ailment from that with definite structural alteration.

A rational therapy necessitates at least a cursory knowledge of the minute anatomical alterations at the root of the symptoms. These changes, which cannot be considered here at length, may be said to consist essentially of a parenchymatous and interstitial inflammation of the secretory glandular structure of the entire mucous membrane of the stomach, especially in the pyloric region, leading to degeneration, atrophy, and abolition of function. In consequence, production of a proper digestive juice cannot occur, but in its stead there may be secreted an alkaline mucus which not only possesses no digestive activity, but which interferes chemically and mechanically with the function of the stomach.

Several forms of chronic gastritis are distinguished, differentiated by the result of examination of the stomach-contents removed fasting and after the test-meal by the tube in the manner already described. These are simple, catarrhal, and atrophic gastritis.[1] They all agree in that there is always an alteration in the character and a diminution in the amount of the digestive secretion, due to an organic affection of the mucous membrane involving the secretory glandular apparatus, and never hypersecretion or hyperacidity through increased formation of hydrochloric acid, which cannot result, in consequence of inflammation of the secretory structure.[2]

It is necessary that the principal characteristics of each form, as shown by an examination of the stomach-contents fasting and after

[1] This classification is that of Ewald, which is very convenient clinically. (*Vide loc. cit.*, and also *Deutsche Medizinal Zeitung*, May 6, 1889.) He also divides functional (dyspeptic) disorders into—(*a*) that with hyperacidity, in which a very acid gastric juice is secreted which digests promptly: in this form the fasting stomach is empty; (*b*) that with hypersecretion, in which the fasting stomach contains gastric juice; (*c*) subacidity or anacidity, that form in which secretion of hydrochloric acid is diminished or absent; (*d*) that with atony of the stomach, in which the gastric peristole is delayed, the ingesta remaining an abnormally long time in the stomach.

[2] As Ewald points out, the tendency of inflammation here, as in secreting glands elsewhere, must be toward cessation of function.

food, be surveyed, since the treatment, which in the main is similar in all, must be modified in some particulars according to the dominance of one or the other variety.

In simple gastric catarrh there is present during fasting small amounts of a mucous watery fluid, frequently bile-stained, and mixed with duodenal contents after removal by the tube. A precipitate of epithelial cells occurs from this on standing, containing numerous round cells and small amounts of food-remnants. After a test-meal, examination shows diminution in hydrochloric acid, pepsin, and the milk-curdling ferment. Peptone and albumoses are, however, formed within as well as without the stomach. Lactic acid and the fatty acids are apt to be present.

In the second variety, mucous gastritis, between which and the first transition forms occur, as they likewise do between mucous and atrophic gastritis, an abundance of mucus is present, both fasting and after food. The acidity is always low. Free hydrochloric acid is almost entirely absent. Peptone exists only in traces; proteoses, however, are formed abundantly. Digestion outside the body is impossible without the addition of hydrochloric acid, and even then it is retarded (showing diminution in pepsin); the milk-curdling ferment is much diminished or absent.

In the more advanced form, atrophic gastritis,[1] toward which the mucous variety gradually tends, during fasting and after food the stomach is quite empty and free from mucus; hydrochloric acid, pepsin, and the milk-curdling ferment are entirely absent, because of complete atrophy of the glandular secretory structure of the mucous membrane.

In the management of chronic gastritis, as in the acute form, our primary aim should be to discover, and if possible remove, the underlying cause, should it still be present, in order that if the gastritis has not advanced to pronounced structural alterations in the tubules a return to the normal may be more rapidly facilitated than if the treatment from the first were chiefly symptomatic.

Recurring attacks of acute gastric catarrh, arising chiefly through over-indulgence of the appetite, whether in food or drink, tend to provoke chronic gastritis. Antecedent acute gastritis may thus originate the chronic affection, or the latter may be occasioned primarily by the gradual action of similar causes operating in the production of the acute form. These the writer has already enume-

[1] While atrophy of the gastric tubules is usually secondary to chronic gastric catarrh, it may less frequently also occur idiopathically, due, as suggested by Meyer (*Zeitschrift f. klin. Med.*, Bd. xvi. p. 363), to disease of Auerbach and Meissner's plexus or of the vagus or sympathetic. Meyer has entitled this form gastric phthisis. It is most common in the aged: the symptoms are those of pernicious anæmia.

rated: they need not be reconsidered. Other causes are the presence of functional gastric derangements, the forms of nervous "dyspepsia" just alluded to, which produce weakness, irritation, and subsequent inflammation of the gastric mucous membrane, through the latter being unable to act properly. Gastric disorders of this type merit prompt and careful attention, lest they gravitate into chronic gastric catarrh or ulcer.

Obstruction to the portal circulation, however brought about, whether by disease of the lungs, heart, or liver, or by anæmic conditions producing weakened heart-action and slight ischæmia, causes gastric catarrh through the mechanical (or passive) congestion of the stomach induced. Ailments thus originating catarrh of the stomach must receive attention before the local gastric conditions can be improved, otherwise remedial measures directed solely to the stomach will be inoperative.

Obstructive disease of the heart and lungs demands such medicaments as digitalis, strophanthus, caffeine, strychnine, and arsenic—agents which remove ischæmia and support the circulation, both directly and indirectly, through their effect on nutrition. If it be necessary to use digitalis or strophanthus for a more or less continuous period, the latter should perhaps first be tried, since, though usually not quite so efficient as digitalis, it is not only without irritating effect on the stomach, but acts as a mild stomachic. Digitalis,[1] on the contrary, is a gastric irritant, and, though its effect in this direction is quite insignificant in comparison with its beneficial influence in removing impediments to the circulation, it is preferable not to resort to it if a substitute can be found. Digitalis might first be used for a short time, until the condition of ischæmia is removed; the equalized circulation may then be maintained by strophanthus and arsenic. When decided anæmia accompanies a failing circulation, arsenic is often more efficacious than digitalis, as was pointed out by Bramwell. The fact that arsenic has a decidedly stimulating effect on gastric digestion, causing pepsin-hydrochloric acid to dissolve a much larger amount of albumin than would be digested were it not present,[2] renders it specially useful in gastritis originated and main-

[1] Leube (*Ziemssen's Cyclopædia*, vol. vii.) is of the opinion that though digitalis causes anorexia, nausea, and vomiting, it should still be employed in gastritis due to obstructive pulmonary and cardiac affections, since the equalization of the circulation it produces will be accompanied by a corresponding amendment in the gastritis. He believes that in those cases in which the cardiac condition is improved without a corresponding amelioration in the gastritis the latter is due to another cause than venous congestion. However this may be, if another drug less irritating to the stomach can replace digitalis, it should of course be used where the function of the latter is disturbed.

[2] As has been shown by Chittenden, *Medical News*, Feb. 16, 1889.

tained by cardiac disease. Free purgation to unload the portal circle is frequently necessary in gastritis due to heart disease, as it is in that arising from disease of the liver. Blue mass, calomel, podophyllin, colocynth, and such salines as sodium sulphate and phosphate, all of which have both a cholagogue action and a depletory effect on the engorged portal viscera, are especially useful. Passive congestion of the stomach causing gastric catarrh, arising through enfeebled heart-action induced by idiopathic or secondary anæmias, requires similar treatment—strophanthus as a heart-tonic; arsenic, strychnine, and iron (with laxatives) to stimulate hæmogenesis.

Wasting diseases and all sources of malnutrition, such as phthisis, chronic malaria, cancer, nephritis, neurasthenia, and old age, predispose to chronic stomach catarrh by the induction of anæmia, gastric atony, and probably degeneration of the vessels of the stomach.[1] The therapeusis of cases of this sort is that of ordinary chronic gastritis, the anæmia and its cause not being overlooked

The remote cause of gastritis having received consideration, we should direct our efforts toward removing the more direct one depending upon the former—an abnormal condition of the stomach permitting fermentative processes to occur—instituting and maintaining a healthy state of the mucosa, and so stimulating its glandular apparatus that the elaboration of a proper digestive fluid will result, the utmost caution being observed during the process of cure that the affected organ is not overtaxed by injudicious feeding. The treatment of special symptoms, such as arise through indigestion and fermentation of the ingesta, must also engage our attention. The habits of the patient should be carefully scrutinized, all those prejudicial to health being corrected. Systematic exercise in the open air, regularity in eating, thorough mastication of food, attention to skin and bowels—in short, all that pertains to general hygiene—demand and must receive as much consideration as the medicinal treatment itself.

In cases of mucous gastritis, in which the lining membrane is covered with a thick, tenacious layer of alkaline mucus, permitting fermentative processes to occur, and both interfering with the elaboration and causing the neutralization of the proper gastric juice, and in those cases of simple gastritis and of gastric atrophy in which, through atony of the mucous membrane, stagnation of the ingesta occurs, it is absolutely necessary, in order to fulfil the first indication above mentioned, that washing out of the stomach be systematically practised.[2] This should be done at least once daily, preferably an hour before breakfast; if twice daily, the second washing should be about an hour before the evening meal and at least five hours after the preceding meal.

[1] Flint in *Reference Handbook of the Med. Sciences.*

[2] The method of lavage is described under Gastrectasia.

Lavage is not only of the greatest utility as a cleanser, removing from the stomach mucus and remnants of undigested food, but it also ranks high as a stimulator of glandular activity. The utility of lavage in this direction is so decided that it cannot well be replaced by the ingestion of fluid to be absorbed from the stomach or to pass onward through the bowel. Lavage should be resorted to in all cases of gastritis, even though unattended by the formation of mucus, in which there is persistent diminution in the formation of hydrochloric acid.

In cases of mucous gastritis the wash-water should preferably be sterilized by boiling. It should be introduced warm, and may be either plain or medicated. When our object is simply to cleanse the stomach-surface in cases characterized by a free secretion of mucus, alkalies having a solvent action on the latter are to be used, such as sodium bicarbonate and chloride, a tea-spoonful or more to the pint.[1] If fermentative processes are occurring actively in the stomach, as shown by the presence of large amounts of the fatty acids, the addition of antizymotics to the wash-water may be necessary. Each washing should be continued until the fluid returns through the funnel clear and free from mucus, care being taken that the stomach is finally entirely emptied when the wash-water contains substances, such as borax, which if left in the stomach might irritate that viscus. If our chief object in resorting to lavage is to stimulate the secretory function, no agent is more beneficial than sodium chloride, which, absorbed into the blood, not only contributes toward the production of hydrochloric acid, but also promotes the transformation of pepsinogen into pepsin.

It requires but few applications of lavage in suitable cases for benefit to be apparent. Improvement is soon so decided that the patient, if at first averse to the use of the tube, becomes accustomed to its manipulation, and could not readily be persuaded to abandon it. Ewald[2] regards no remedy of greater service in the

[1] It is perhaps better in all forms of gastric catarrh to use an alkalinized water, preferably containing sodium bicarbonate and chloride, since in all forms of stomach catarrh diminution of secretion of pepsin-hydrochloric acid occurs. Both of these sodium salts, when employed in small amount, stimulate the elaboration of gastric juice. One of the methods in use (Leube, *Deutsches Archiv f. kl. Med.*, Bd. 33, p. 12) for ascertaining the condition of the secretory activity of the peptic glands is based on this well-known stimulating power of alkalies, especially of sodium carbonate, on the secretion of pepsin-hydrochloric acid: 50 ccm. of a 3 per cent. solution of sodium are introduced into the fasting stomach, cleansed by lavage, and after twelve minutes are withdrawn through the tube by the aid of 500 ccm. of lukewarm water. If the water fails to react acid, a decidedly diminished secretion or suppression of the gastric juice exists. (For the influence of sodium carbonate on the secretion of gastric juice in chronic gastritis, see also Leube, *Ziemssen's Cyclopædia*, Am. ed., vol. vii. p. 189.)

[2] *Klinik der Verdauungskrankheiten*, p. 298.

treatment of chronic gastric catarrh. He states that cases which have been subjected to all varieties of treatment save lavage for months or years without benefit, have been either rapidly improved or entirely cured by the latter; employed, of course, in conjunction with other rational measures which alone have been inefficient. My own experience, though less extensive than Ewald's, is in accord with this.

When lavage is impracticable, whether because the case is too mild to require it or the prejudices of the patient forbid its use, the ingestion of half a pint to a pint of hot water containing a little sodium bicarbonate and common salt may be substituted for it. This should be taken on the empty stomach in the morning and before the last meal of the day, at the time recommended for lavage, or in its place, when available, one of the more palatable natural saline waters may be drunk, such as the German Kissingen (Rakoczy) or Wiesbaden (Kochbrunner), as recommended by Boas,[1] the use of which for periods of three or four weeks in cases of diminished gastric secretion he has found induces an increase. These waters consist essentially of a weak solution of common salt and of alkaline carbonates, especially that of sodium, and can, for all practical purposes, be replaced by the addition of sodium chloride and bicarbonate to ordinary water. Natural saline waters of our own country which resemble in composition the German spring waters are also very numerous. There seems no doubt as to the efficiency of sodium chloride and sodium bicarbonate, when taken fasting in small quantities, as stimulators of gastric secretion. Abundant experimental and clinical evidence has shown their great value. The action of sodium bicarbonate in this direction seems to be entirely local,[2] while that of common salt is both local and systemic. "An acid on one side of a secreting membrane, an alkali on the other, is the condition most favorable for osmosis" (Bartholow). Small doses of sodium bicarbonate ingested on the empty stomach stimulate an outflow of gastric secretion, which it in part neutralizes: after the neutralization of alkali the flow continues, and is decidedly greater in amount than if its secretion has not been thus induced. If taken in decided doses, whether during fasting or after food, the gastric secretion is neutralized and digestion disturbed. Absorbed into the blood in large amounts, the alkalinity of that fluid is increased and diminished secretion of hydrochloric acid is likely to result.

The effect of sodium chloride on gastric secretion and digestion

[1] *Diagnostik und Therapie der Magenskrankheiten*, p. 262

[2] It would seem that all CO_2 waters powerfully stimulate the secretion and absorption of the stomach (Ewald, *op. cit.*, p. 300). So that the special action of sodium bicarbonate is not alone due to its base. The contact of CO_2 with the mucous membrane of the stomach not only excites the secretion of gastric juice, but also assists in ridding the stomach of the various gases present through fermentation (Leube).

seems to differ somewhat according to whether it is taken on an empty stomach or during digestion. The more recent experiments of Roberts and others[1] with artificial digestive mixtures show that common salt, introduced into the mixture in even very small quantities after digestion has begun, has a very considerable inhibitory effect on this process, and with 0.5 per cent. (or 1 : 200) this retardation is so great as to check further digestive action. This would appear to be due in some way not comprehended to the influence of sodium chloride, as of other salts (the action of which we can more easily understand), on the gastric juice already secreted, rather than on the mechanism of elaboration. In this connection it is of importance to note a highly significant fact pointed out by Sherican Lea[2] in comparing the results of artificial digestion and of normal gastric digestion, as it may explain the contradictory conclusions reached by clinical and laboratory experimenters in this field.

Lea points out that the conditions under which the two processes occur are very dissimilar. In natural gastric digestion, in addition to fresh secretion of gastric juice continually being produced, constant movement of the chyme is taking place, and the products of the metamorphosis of the ingesta are being incessantly removed. Conditions, therefore, are very favorable for rapid absorption of a soluble salt, such as sodium chloride, little remaining in the stomach to interfere with the digestive process unless much has been introduced; so that the inhibition of digestion that occurs in the test-tube is probably not repeated normally in the stomach.

The local effect of common salt in small amount is stimulating to pepsin-hydrochloric-acid formation and to the transformation of pepsinogen into active pepsin. Systemically, it unquestionably contributes to the formation of the gastric acid,[3] the production of the latter entirely ceasing during sodium chloride starvation, as Cahn[4] and Voit[5] have shown.

The frequent use of mild saline laxatives, particularly waters containing sodium chloride and bicarbonate, besides their special laxative salt (preferably sodium sulphate), is of distinct service in synergizing the effect of lavage in cleansing the stomach of mucus, promoting a healthy condition of its walls, and influencing its functions generally for good, even when lavage alone, as commonly happens, promotes

[1] Boas, *op. cit.*, p. 261. See also Roberts, *Digestion and Diet*, Phila., 1891, p. 146, *et seq.*

[2] *Journal of Physiology*, p. 226, vol. xi., 1890.

[3] The source of the hydrochloric acid is undoubtedly the sodium chloride of the blood and lymph (Landois and Stirling, *Physiology*).

[4] "Die Magenverdauung im Chlorhunger," *Zeitschr. f. Physiol. Chem.*, Bd. x., p. 522, *et seq.*, quoted by Boas, *op. cit.*, p. 261.

[5] Landois and Stirling, *loc. cit.*

regular alvine evacuations through its stimulating effect on gastric and intestinal peristole.

Saline laxatives also relieve the engorged condition of the mucous membrane by their depletory influence on the portal circulation. Carlsbad waters and salts,[1] which consist essentially of sodium sulphate, bicarbonate, and chloride, are of special value if not employed too continuously or in too great quantities.

Ewald and Sandberg's[2] recent investigations into the influence of these waters on the gastric functions show that their absorption is very rapid, especially when ingested warm; that they have a much greater stimulating influence on the stomach than simple water, decidedly augmenting gastric secretion, the hydrochloric acid, pepsin, and rennet-ferment being greatly increased after a time; and that this influence is maintained even after a five or six weeks' course of the waters.

No remedy has been more widely used than silver nitrate in chronic catarrhal conditions of the gastro-intestinal tract. The extended employment of this salt would indicate its utility, which seems, however, founded on no definitely known physiological effect. It is said to possess sedative, astringent, and alterative properties. However it may act in promoting a healthy condition of the mucosa in gastric catarrh, the fact that it is of benefit in moderate doses, in connection with the use of the stomach-douche, is undoubted, and a lack of a clear conception of

[1] There is now prepared in Carlsbad, after the formula of Professor Ludwig of Vienna, and sold in this country through the Elsner & Mendelson Co. of New York, Carlsbad salts in powder form, representing all the saline ingredients of Carlsbad water. It is termed "Natural Carlsbad Sprudel Salt in powder form." Its formula is:

Lithium bicarbonate	0.39 per cent.	Sodium fluoride	0.09 per cent.
Sodium bicarbonate	35.95 "	Sodium borate	0.07 "
Sodium sulphate	42.03 "	Silicic acid anhydride	0.03 "
Sodium chloride	18.16 "	Iron oxide	0.01 "
Potassium sulphate	3.25 "		

This powdered Carlsbad salt is infinitely preferable in cases of gastric catarrh to the crystallized Sprudel salt prepared after Becher's formula, which is also largely used. The latter's chief ingredient is sodium sulphate, it containing less than 1 per cent. of common salt and but 5 per cent. of sodium carbonate. The crystalline salt should be used in those cases in which a cholagogue and purgative action only are desired. The powdered Sprudel salt, on the contrary, quite well replaces the water. According to Jaworski, who has elaborately investigated the subject (*Action, Therapeutic Value, and Uses of Carlsbad Sprudel Salt* (powder form), translated by Toboldt, P. B. Blakiston, Phila.), this salt has very nearly the same therapeutic effect on the stomach as the Carlsbad water, though it is less stimulating. Jaworski found that the gastric juice becomes capable of peptonization earlier, and that the stimulating effect on secretion lasts longer, after the water than the salt. He also noted that while warm Carlsbad water is more stimulating to the gastric function than cold, the contrary is the case with the salt; which latter should therefore be administered in cold solution if the object is to stimulate gastric secretion rather than intestinal peristalsis.

[2] *Centralbl. f. med. Wissensch.*, 1888, p. 396.

its effects should not militate against its employment on the face of the clinical evidence in its favor. It is of far more utility as a sedative and astringent than bismuth, much used in the same class of cases, and should be administered in doses of $\frac{1}{8}$ to $\frac{1}{4}$ grain three times daily, combined with a small quantity of belladonna or opium, a half hour or more before meals, when gastralgia or deep-seated tenderness, indicating a pronounced inflammatory condition of the stomach, is present. This may be continued for a month or six weeks, and after an intermission again resorted to should its employment seem to have been of benefit.[1] Subacute inflammatory conditions of the stomach accompanying chronic gastritis, especially that of drunkards, in which the tongue is abnormally red and the papillæ prominent, are often quickly relieved by zinc oxide in 3- to 5-grain doses, or a preparation of bismuth, the subnitrate or carbonate, in doses of 5 to 20 or more grains. These may be administered alone or in combination with dilute hydrocyanic acid, or with morphine if decided epigastric tenderness exists. They should, of course, be taken on the empty stomach.

In addition to the steady employment of lavage, or the use of large draughts of the saline waters on an empty stomach half an hour to an hour before meals, once or twice daily, as a cleanser of the mucous membrane and as a stimulant to the secretory activity of the stomach, other agents exerting an influence for good in the latter direction also deserve special notice. The chief of these is hydrochloric acid, the use of which serves a triple purpose in chronic gastritis. It stimulates the formation of pepsin, and perhaps its own secretion; it acts as a digestant when its secretion is diminished, and as an antizymotic, inhibiting fermentative processes which constantly occur in the stomach in this disease through lack of formation of hydrochloric acid and because of diminished peristole. As a stimulator of glandular activity hydrochloric acid takes high rank. It is, however, indicated for this purpose only in cases in which complete atrophy of the tubules does not exist, when free hydrochloric acid is still secreted, even if only in traces, as is shown by the digestive test outside the body. Should the gastric filtrate alone, or with the addition of hydrochloric acid, digest egg-albumin or blood-fibrin, and if the lab-test is positive, hydrochloric acid may be employed with benefit.[2] Under its use, especially when

[1] A word of warning is here necessary regarding the dose of silver nitrate frequently advised. The use of a grain three times daily, the maximum given in many textbooks, is not unattended with danger, and should not be prescribed except, perhaps, in gastric ulcer, where the benefit anticipated from its employment for a short time seems greater than the risk encountered from the use of a dose so large. Apart from the danger of argyria from its continued use, neuritis and kidney degeneration may occur. Gowers (*Diseases of the Nervous System*, p. 321, 1888) states that a grain a day has been said to cause fatal kidney disease, and he has seen a case in which a much smaller dose, taken daily for nine months, caused albuminuria.

[2] Boas, *op. cit.*, p. 249.

combined with common salt, secretion of a more active gastric juice occurs spontaneously.[1] Its mode of administration will be discussed under that of Artificial Digestants.

The employment of some of the so-called stomachics, though of less utility in chronic gastric catarrh than the secretory stimulants already mentioned, deserves attention. The chief of these is certain of the bitters, the influence of which, however, on the secretory process in gastritis is less beneficial than in functional (nervous) atony of the stomach.

When, however, a subinflammatory condition is present, as in slight cases of gastritis or in the more severe forms of mucous catarrh ameliorated by careful diet and lavage, in which the tongue has lost its angry appearance, and it would seem that a mild stimulant is all that is necessary to provoke healthy glandular activity, the bitters, such as nux vomica, quassia, calumba, condurango, and gentian, may be of great utility. But for the purpose of stimulating secretion they should be administered, unlike hydrochloric acid, before and not after meals. Though their mode of action is somewhat doubtful, their effect in suitable cases is very certain. In the mouth they increase salivary secretion, and thus aid starch digestion. In the stomach in small doses the slight irritation they cause may be interpreted as appetite.[2] As suggested by Brunton, when appetite is thus induced putrefactive processes which might otherwise occur in the stomach, and that languor and discomfort which accompany impaired digestion, are diminished. The effects of bitters are probably due entirely to the promotion of a better secretion of gastric juice. The most recent investigation into the influence of bitters on the stomach during digestion is that of Reichmann,[3] who examined into their direct influence on the secretion of the fasting stomach, on their effect subsequent to their disappearance from the stomach, their action when employed for some time, and the influence exerted on the duration of digestion. He found that though the secretion immediately produced during fasting by bitters was less in amount than that induced by distilled water (its digestive

[1] Boas, *op. cit.* According to this author (p. 249), who doubts the generally-accepted notion as to the utility of hydrochloric acid as an artificial digestant in cases in which its secretion is much diminished or entirely absent, the administration of hydrochloric acid is useless except as an antifermentative, and it should not be employed if the digestant test for pepsin and lab-ferment, reinforced by hydrochloric acid, results negatively.

[2] Brunton (*op. cit.*, p. 144) suggests that appetite is only an expression of mild uneasiness on the part of the stomach. The latter not being able to distinguish sensations, as does the mouth, when very slightly stimulated develops appetite. Thus, quassia, which causes a bitter taste, and minute doses of tartar emetic and arsenic, which would produce congestion if they remained in the mouth as they do in the stomach, all cause appetite. They probably do this by exciting a slight amount of hyperæmia.

[3] *Centralbl. f. med. Wissensch.*, p. 618, 1888.

power being slight with hydrochloric acid diminished or absent), after the disappearance of the bitter from the stomach the secretion was greatly augmented, the quantity of hydrochloric acid and the digestive power much increased. He also found that during digestion in a healthy stomach bitters diminished digestive activity; that in lessened secretion and in hypersecretion acidity was increased, but in anacidity no effect was produced; and that no ill resulted from the prolonged use of bitters in healthy or diseased stomachs. These experiments confirm a fact already established empirically, that bitters are of most benefit where digestion is imperfect through diminished production of gastric juice, and that they should be administered before (preferably at least half an hour) and not after meals. Nux vomica is probably the most useful of the bitters, it having a special stimulating action on the nerve-centres by which the co-ordination of the digestive process is rendered more perfect.[1] It may be given in the form of tincture in doses of from 5 to 20 drops. When Carlsbad or other saline water is taken once or twice daily before meals, the tincture of nux vomica or other bitters employed may be added to the water, the action of which will thus be synergized. The tincture of nux vomica or one of the bitter infusions, such as quassia or calumba—these latter in doses of $\frac{1}{2}$ to 1 fluidounce—may be prescribed in combination with 10 or more grains of sodium bicarbonate, to be taken in hot water half an hour before meals. This the writer frequently uses with the best effect. Cannabis indica, in doses of 5 to 10 minims of the tincture and $\frac{1}{4}$ to $\frac{1}{2}$ grain of the extract, has recently been highly extolled in gastric disorders in cases in which acids and nux vomica seemed inefficient. The alkaloid strychnine, or preferably its more soluble sulphate, is often of greater value than nux vomica, especially in the gastric catarrh of drunkards. It may be given in doses of $\frac{1}{60}$ to $\frac{1}{20}$ of a grain, after meals, in combination with hydrochloric acid, or before meals in pill form, or, when an alkali is not taken, dissolved in dilute hydrochloric or nitro-hydrochloric acid.

Condurango, belladonna, and ipecac are also useful as stomachics. With the former, which Ewald employs in combination with dilute hydrochloric acid, the writer has had no experience. The effect of belladonna as a peristaltic stimulant is unfortunately counterbalanced by its influence in diminishing secretion; hence, according to the writer's opinion, it had better not be resorted to save in small doses, united with laxatives, at bed-time. Ipecac, as a laxative, is efficient also as a stomachic, combined with aloes or other purgatives, in pill form and administered after meals.

Of orexin muriate, a benzyl derivative, proposed by Penzoldt[2] as a promoter of gastric secretion and of appetite, of which at first so much

[1] Brunton, *op. cit.*, p. 68.

[2] *Therapeut. Monatshef.*, p. 59, 1890.

was expected because of Munter's and Penzoldt's investigation,[1] little more need be said than that the results of its earlier use have not been confirmed by later experiments, and that if it be thought worthy of trial it should preferably be exhibited in wafer, paper, or gelatin capsules, since pills made of it do not readily undergo solution in the stomach. The dose as employed by Penzoldt was from 5 to 7 grains once to twice daily. A burning sensation in the œsophagus and occasional vomiting were observed after its ingestion, to avoid which Penzoldt recommends that a large cup of beef-tea be taken along with it.

Alcohol, or beverages containing it, so useful as a stomachic in conditions of simple atony of the mucous membrane, is harmful in gastritis, and if employed at all should be only in the form of a light wine. In drunkards' catarrh it is sometimes difficult to withhold stimulants, the cause of the gastritis. These subjects are often unable to take the morning meal until a small quantity of spirits has been imbibed, which not only assuages nausea, but enables them to take, retain, and digest food when they otherwise could not. In these, morning lavage to remove stomach-mucus, or a tumbler of warm solution of Carlsbad salts, the former succeeded by the latter, which may contain 10 or 20 drops of tincture of nux vomica, will often be found to remove the craving for alcohol and disgust for food, the latter of which, unless predigested, should be succeeded by dilute hydrochloric acid.

Douching and massage of the stomach are recommended as secretory exciters. They are of more value in cases of decided muscular atony as stimulators of peristole, and will be considered in the treatment of Atonic Dilatation. That the intraventricular application of both faradic and galvanic electricity has the power not only to increase gastric motility, but also to excite secretory activity in both normal and diseased stomachs, there is no doubt, though its exact value as a curative in gastric diseases is still *sub judice*, experimentation with the direct application in these being of comparatively recent date, and not yet extensive enough to permit of generalization of results. Most perhaps may be expected from electricity in cases of diminished secretion due to simple or nervous atony, and least in cases in which a marked inflammatory element exists or where decided atrophy of the tubules has occurred.

Though the ability of both currents to increase secretory activity has been established by experimentation, faradism has been more resorted to than galvanism; and, curiously, good results have been obtained with the same current similarly applied in antithetical cases of gastric disorder, those with hyper- as well as subacidity yielding to its employment. Stockton[2] is inclined to seek for an explanation of

[1] The former of whom noted the appearance of free HCl in the gastric secretion in from a half hour to one hour earlier after its use than when it was not employed.

[2] "Results of Gastric Faradization," *Amer. Journ. Med. Sciences*, July, 1890.

this through the beneficial influence of electricity upon innervation, a disorder of which, he believes, underlies both classes of ailments. Einhorn,[1] who has recently reviewed the literature of electricity in diseases of the stomach, in describing an excellent electrode which he has devised for its application—much more convenient than any before constructed—after citing three cases (normal) in which, fasting, a few minutes' intraventricular application of faradism decidedly increased acidity, inducing a response to Günzberg's test, which previously could not be obtained,[2] reports markedly beneficial subjective and objective results (the latter shown by chemical tests) in chronic catarrh of the stomach. In two aggravated cases in which free hydrochloric acid could never be found after the test-meal, it could be detected after the stomach had been faradized internally for ten minutes. In view of these results, which are but a confirmation of those obtained by others,[3] it would appear that there is much to expect from the direct application of electricity in diseases attended with secretory inactivity, and its usefulness seems equally happily exerted on the absorbent and motor functions, both of which are more or less affected in gastritis. Theoretically, for reasons which lack of space forbids us to detail, galvanism, with the anode in the stomach and the cathode externally, should be preferred when it is desired to stimulate secretion and absorption; and faradism, when it is desired to excite the gastric peristole. However, it would appear in practice that more striking results have been obtained in all the directions with faradism, the use of which, therefore, the writer would recommend in all cases of gastritis not yielding to simple remedies, in which there is a decided and persistent diminution in the formation of hydrochloric acid.

The lack of a convenient electrode for direct electrization has caused this method of application until quite recently to be but little resorted

[1] *Medical Record*, May 9, 1891.

[2] His method in these was first to ascertain the condition of the stomach fasting, testing the removed contents, if any, for free hydrochloric acid: 100 ccm. of water and the electrode were then introduced and permitted to remain for ten minutes, no current passing. The electrode and the stomach-contents were then withdrawn, and the total acidity of the latter and its response to hydrochloric acid by Günzberg's and other tests noted. The electrode and 100 ccm. of water were again introduced, the current closed by the subject grasping the second electrode in the hand, and a mild faradic application made for ten minutes. The stomach-contents were then re-examined, with the result above cited.

[3] The writer has not yet employed the intragastric application of electricity with sufficient frequency in any one class of cases to form more than an approximate idea as to its utility. He may, however, state that the results obtained are favorable as to its use in cases characterized by lessened secretory and motor activity. He has recently used entirely the Einhorn electrode made for him by Otto Flemming of Philadelphia. This is unquestionably more convenient than that of Bardet or any modification of the latter, such as Stockton's. Einhorn's electrode is manufactured in New York City by Messrs. John Reynders & Co.

to, and forced Ziemssen[1] to abandon it after a trial as too straining and exhausting, he having used an electrode introduced through the stomach-tube. However much the precutaneous applications may influence gastric peristalsis, electricity thus used can be of only the slightest service as a secretory excitant, especially faradism, the penetrative power of which is almost *nil*.

The electrode devised by Einhorn, which is as easy of application as it is of ingenious construction, removes the objectionable feature of its predecessors, that of having to retain in the throat during the whole time of the electrical session a thick tube, the sensation of which, except to those accustomed to the use of the tube for lavage, is so highly unpleasant as to cause a desire to forego its application. Einhorn's electrode consists of a small hard-rubber, numerously perforated, oval capsule, joined near its centre by a screw-thread, by which it may be separated, containing in its interior a small metallic button, about which absorbent cotton is placed to prevent the stomach-walls coming in contact with the button through the perforations. The capsule is united to a fine rubber tube (1 mm. in diameter), through which a very fine, soft conducting wire runs, connecting the electrode with the battery. The mode of application of this electrode is similar to that of those applied through the stomach-tube. A half pint to a pint of warm water, simple or saline, is ingested fasting, preferably half an hour or an hour before a meal, and the electrode swallowed. The latter is readily accomplished by placing the electrode on the root of the tongue and taking a draught of water. The electrode is washed into the pharynx and more water drunk; it then readily slips into the stomach. The rubber tube should contain a distinguishing mark at a distance of about 40 cm. from the capsule, that it may be known when the latter has reached the stomach. The indifferent large electrode is placed on the back to the left of the seventh dorsal vertebra or in front at the epigastrium, or held in the hand, and the current turned on and slowly increased until it is slightly felt. Subsequent to the application the electrode is readily removed by drawing gently at the rubber cord. If resistance is felt at the introitus œsophagi, the patient is directed to swallow; the electrode is then liberated, and is easily withdrawn without force being applied. Before this the current should have been gradually diminished, shocks being avoided. If galvanism is used the current should be controlled by a rheostat. The duration of the sitting should be about ten minutes and the applications made daily.

When our object is secretory rather than motor stimulation, considerable strength of current should not be used, lest by over-stimulation we defeat the end in view. The stomach containing considerable fluid during the application, the current is diffused throughout its sur-

[1] Quoted by Einhorn, *loc. cit.*

face, and comes into contact with all parts at and below the level of the fluid. When it is especially desired to affect secretion, the writer makes the application with the patient recumbent, alternately supine and prone, that the cardiac portion, in which the chief secreting structure resides, may particularly come under the current influence.

It is perhaps needless to urge that the diet can scarcely be too carefully regulated in gastritis. The secretory glands are always affected, and in pronounced cases their function is profoundly disturbed, while the absorbent and motor powers are likewise deranged, as has already been stated. Stomach digestion, in any save the mildest cases, cannot be efficiently performed except with artificial aid, and with this rendered, as it always should be to preserve adequate bodily nutrition, the food must still be of the simplest and most digestible character. When digestion is much disordered and nutrition fails, the patient not responding well to a regulated general diet, milk may be tried exclusively for a short time, should it agree, in order to place the inflamed organ in a state of as complete rest as possible. It cannot, however, form the sole food for any length of time without nutrition suffering, for, as Ewald[1] intimates, a purely milk diet is equivalent to slow starvation. It is only indicated for short periods when subacute catarrhal conditions complicate the chronic inflammation. It should be given skimmed, warmed, and with an alkali added to assist in its digestion—sodium bicarbonate preferably to lime-water, since the latter is but feebly antacid. Roberts recommends the addition to each glass of a powder consisting of 10 grains each of sodium bicarbonate and common salt, and 5 grains of light magnesia, and also suggests that one-third hot water added to plain milk will aid in its digestion. In the gastric catarrh of alcoholics, when thirst is excessive, he has seen excellent results from the use of equal parts of milk and Apollinaris water. Constipation accompanying milk diet is readily relieved by use of Carlsbad (or similar) salts. Peptonized milk or peptonized milk-gruel may replace milk should the latter prepared as indicated not agree. Other peptonized foods are also necessary for short periods to relieve the overtaxed organ, or for more lengthened ones in conditions of atrophy of the gastric tubules, when the administration of the digestive ferments will not render the simplest aliment well borne. Of the peptonized preparations, those of beef are especially indicated in advanced mucous catarrh and in atrophy, owing to the prolonged imperfect digestion of albuminoids tending to result in nutritional changes which may lead to the development of tuberculosis or of fatal anæmias. The best preparation of peptonized beef, and one which the writer has recently used largely in various combinations, since it incomparably outranks all in nutritive value, is that sold under the

[1] *Op. cit.*, 303.

name of "Mosquera's beef-meal." This preparation consists of lean beef digested while fresh with the juice of the pineapple until most of the proteid tissue is transformed into proteoses and peptones, and then desiccated. Ninety per cent. of this beef-meal is nutriment, of which 77 per cent. is albuminoid matter and 13 per cent. fat,[1] according to the analysis of Chittenden. Of the 77 per cent. of albuminoid matter, 29.43 per cent. is in the form of soluble digestive products, albumoses, and peptones, ready for immediate assimilation. Chittenden believes that the insoluble albuminoid matter (48 per cent.) is, through the action of the digestant, so disintegrated that it is apparently more readily soluble in the natural digestive juices and more available for nutritive purposes than ordinary muscle-tissue, although it has not been converted into proteoses or peptones. This preparation, which is unparalleled as a nutrient, is without the disagreeable smell or taste attached to peptones digested with pepsin or trypsin. Though quite insipid in its plain state, it can be made palatable enough by flavoring with salt or, preferably, by combining it with other foods, especially with pleasant-tasted meat-soups or broths. The writer is now using largely a very agreeable, tasteful mixture of it with equal parts of sugar and cacao. This should be taken with hot milk, and makes a palatable and nutritious beverage. The soluble digested portions of beef-meal, evaporated to a pasty consistence, are also prepared separately under the name of "Mosquera's beef-jelly." This has the appearance of an ordinary beef-extract, has an agreeable odor and a pleasaut flavor, and when added to boiling water makes a clear bouillon infinitely more nutritious than any ordinary extract of beef. Beef-jelly is to be preferred to the uncombined meal, as it is much easier taken and better borne by the stomach; patients, too, are less apt to weary of it. It, like the meal, may be added to ordinary consommé, chicken, or mutton broth. The yelk of an egg, made into a paste with a teaspoonful of the jelly and dissolved in a cup of boiling water, increases its nutritiousness and palatability.

But patients soon tire of artificially digested foods, and, however well they may be borne at first and how much relished, the palate and stomach are soon apt to weary of them and rebel. They are only constantly indicated in advanced mucous catarrh and atrophy, when hydrochloric acid and pepsin are persistently absent from the gastric secretion. They should then be frequently varied, and perhaps occasionally alternated with very easily digested albuminoid aliment, given along with pancreatin and sodium bicarbonate. When more solid food is indicated, it must be, of course, most thoroughly masti-

[1] A detailed description of this preparation, and an analysis of comparative values of this and other beef-products, are made the subject of an interesting paper by Chittenden in the *Medical News*, June 27, 1891.

cated and insalivated to aid the saccharification of any starch present, to furnish a stimulant to gastric secretion through the act of mastication and the influence of swallow-saliva, and finally to so prepare the bolus that the work of solution in the stomach will be at a minimum. Much food should not be eaten at one time, and if digestion is much delayed a sufficient interval must elapse between meals to permit the stomach to empty itself. When solid food can be taken, albuminoids are preferable to carbohydrates, since, though perhaps less easily disposed of without artificial digestants, they are less apt to cause fermentative changes than a farinaceous dietary, so largely composed as it is of starches and sugar, which readily undergo decomposition in the stomach, with the production of irritating organic acids. Eggs, soft-boiled, their albumin becoming opaque, though remaining semifluid; short-fibred, tender meat free from fat; boiled mutton or roasted tender beef; broiled tenderloin of steak,—may be permitted, provided they are digested without discomfort with the assistance of hydrochloric acid, and, if necessary, pepsin. Meat should not be prepared for the table until rigor mortis has passed off, it then being more tender and digestible. Leube admits into the dietary fish and boiled veal free from fat. The tender part of oysters raw or lightly broiled or panned may be taken, as may also well-made stale white bread, fresh young peas, carrots, asparagus, and occasionally rice well boiled, and a small part of very mealy potato. In mild cases of gastritis, in which fermentative processes do not readily occur, uncooked, and especially cooked, fats are wholly inadmissible, since they mechanically delay gastric digestion by impeding penetration of the gastric juice, forming a coating about otherwise soluble ingesta, and increase the unhealthy condition of the mucous membrane by the irritating influence of fatty acids developed from them. The only exception that can be made is butter in small quantity spread very lightly upon bread, and occasionally, when it seems to agree, a little cream used as a sauce.

Condiments, except salt, are to be avoided. Broths or soups made from meat-extracts, and beef-tea, must be partaken of sparingly, if at all, at the time other food is eaten, because of the neutralizing effect of the salts they contain on the gastric acid, thus impeding digestion very decidedly.[1] They may, however, be taken with benefit in small quantity at the beginning of a meal, before other food is eaten, for then the hot solution would be most readily absorbed from the mucous membrane, in passing through which stimulation of its secretory and muscular activity could occur, resulting in increased vigor of digestion.

[1] Tea has a powerful inhibitory effect on starch digestion, which may be overcome somewhat by its being taken weak, used sparingly, and only after a meal; it is rendered entirely harmless by the addition of a pinch of sodium bicarbonate to the teapot on making the infusion—about 2 per cent. (Roberts, *op. cit.*, p. 123).

In this connection it may be mentioned that Schiff[1] supposes that substances which he styles peptogens—meat extracts (or soup), solutions of dextrin, infusion of green peas, bread (which contains dextrin), gelatin, and peptone—when taken on the fasting stomach and after being absorbed into the blood possess the power of stimulating the secretions of gastric juice, and that this effect is also produced by them when ingested into the blood, cellular tissue, or rectum. Cold drinks should be avoided, all fluids being taken, as suggested by Ewald, with the "edge off." If tea and coffee are used, they must be drunk very weak and without cream or sugar, and after rather than with the meal.[2] To assist the digestion of unpeptonized albuminoid aliment, hydrochloric acid should be given when the former causes the slightest discomfort, unless complete atrophy of the gastric tubules is suspected, shown by entire and persistent absence of pepsin-hydrochloric acid and rennet-ferment in a person in whom nervous anacidity can be excluded.[3] In complete gastric atrophy it is useless, of course, to attempt to arouse to activity tubules the secretory function of which is permanently abolished: hydrochloric acid then is not indicated, since the benefit arising from its use as a supposed digestant seems to be as much due to its power to stimulate the transformation of pepsinogen into active pepsin as to act as a synergist to pepsin acid already formed.

As Boas[4] points out, an amount of this acid so great as to be impracticable of administration would be required as a digestant in case of its entire absence, because the greater portion would disappear in forming combinations with the albuminoids and salts present in the food, sufficient not remaining to appear as free acid. Boas therefore regards hydrochloric acid indicated, except as an antizymotic, only when the stomach-contents alone or on the addition of hydrochloric acid digest egg-albumin or fibrin energetically, and if a response occurs to the lab-zymogen test. If the digestion-test results negatively or weakly, and if the test for lab-zymogen shows much diminution, Boas uses hydrochloric acid merely as an antifermentative, his idea being that sufficient cannot be administered when its secretion is suppressed, or even much diminished, to be of practical benefit as a digestant. With the latter supposition the writer cannot agree,

[1] *Leçons sur le Physiologie de la Digestion*, Paris, 1867, vol. ii.

[2] The caution is again necessary that we cannot rely alone on the negative response to Günzberg's and Boas's tests as to the absence of hydrochloric acid. The $CaCO_3$ test should be applied.

[3] The utmost caution is necessary in differentiating these two affections, the prognoses of which differ so widely. In the absence of other subjective symptoms leading to a separation, it is only the prolonged (for months) and persistent absence of hydrochloric acid which justifies the diagnosis of atrophy.

[4] *Op. cit.*, p. 249.

believing that when complete atrophy does not exist and secretion of pepsin and acid occurs, yet not enough of the latter to render the pepsin active, the timely administration of hydrochloric acid in full doses, 20 minims of the dilute acid largely diluted, and repeated at intervals of twenty minutes to half an hour until one or two drachms have been taken, will not only satisfy the yet uncombined albuminoids and salts present in the food, but will leave sufficient free acid for efficient digestion.

The indications for hydrochloric acid in chronic gastritis may be thus briefly formulated: It should be employed in all cases in which digestible albuminoid food causes discomfort, and in which the result of the chemical tests shows evidence of some secretory activity on the part of the tubules. It is preferably administered in doses of from 10 to 30 drops of the official dilute acid, to be taken through a glass tube in sufficient water to cover the sharp taste, the initial dose to be taken half an hour after meals, and repeated at intervals of half an hour until two, three, or four doses are taken, the number depending upon the readiness with which the symptoms are controlled. The initial dose should always be delayed until a short period after the meal in which amylaceous food forms a part, in order that the saccharification of the latter—which, initiated in the mouth, continues in the stomach until the acidity of its contents becomes raised—be not interfered with in the early part of gastric digestion. The acid may be combined with glycerin, and, if anæmia is present, with the official liquor acidi arseniosi, which is a decided synergist to pepsin-acid digestion.

Pepsin, an enzyme that a host of medical purveyors throughout this country are vieing with each other in strenuous efforts to produce in such a state of purity that its digestive activity may equal thousands of its own weight, indicating, therefore, decided demand for its employment, and hence its great utility (?), is very frequently unnecessarily prescribed in apeptic conditions. This fact, however, is not generally understood, and with an entirely erroneous notion as to the indications for its use pepsin is far oftener ordered than is hydrochloric acid, and frequently not only without combination with acid, but it is actually prescribed with an alkali,[1] such as sodium bicarbonate, the influence of which would be to destroy the activity of the ferment thus administered and diminish its natural production by its neutralizing effect on hydrochloric acid. Though the writer believes that this wholesale prescribing of pepsin is unnecessary, he does not take the extreme view of Boas,[2] a

[1] A combination only indicated in those very rare cases of stomach neurosis in which hypersecretion or hyperacidity occurs, due to much increased production of hydrochloric acid, with diminished formation of pepsin—a condition never present in gastritis.

[2] *Op. cit.*, p. 254. Boas holds that pepsin is practically useless in conditions in

corollary to that of his already cited as to the indications of hydrochloric acid, that it cannot be of service in any condition of disturbed digestion except in those rare cases (mentioned in a preceding foot-note) of gastric neuroses in which there is an untoward relation between the secretion of hydrochloric acid and pepsin. The writer believes—and clinical experience supports his contention—that conditions exist in diminished secretory activity in which pepsinogen as well as acid formation occasionally is lowered, though never to an equal extent, since the pepsin cells are far more numerous and more widely distributed than the acid-producing cells. For he has occasionally encountered cases in which symptoms of indigestion due to diminished secretion of gastric juice were only ameliorated by hydrochloric acid, and did not disappear until pepsin was conjointly prescribed. Such positive evidence is of course of more value than any theoretical considerations to the contrary. Another fact must also be borne in mind in considering the indications for pepsin: that, unlike the case with hydrochloric acid, with which digestion is most active when present in about 0.2 per cent., and is retarded when much below or above this amount, the speed of digestion is in direct proportion to the amount of pepsin present, without any limit, according to Roberts, so that no harm can result from a reasonable excess. But in view of the fact that pepsin, unlike hydrochloric acid, possesses great continuous activity, acting by mere presence, that this is not so persistently diminished from the gastric secretion as is hydrochloric acid, and that the albumin of the latter greatly stimulates pepsin-formation, it may be seen that at least in most cases it is more frequently used than is necessary When pepsin is thought to be indicated, it should be prescribed in one or more doses of 5 grains. It may be conveniently combined with dilute hydrochloric acid, glycerin and orange-flower water (or other pleasant excipients) being added as diluents.

When the addition of farinaceous aliment to the dietary seems essential, decidedly beneficial results are often obtained by the use of an active pancreatic extract,[1] preferably administered in solution immediately before or during the first part of the meal. This assists in the

which the formation is diminished or absent if secretion of hydrochloric acid is likewise lessened or in abeyance (as always occurs in gastritis), because the appearance of pepsin (the transformation of the proenzyme into pepsin) depends upon the presence of the hydrochloric acid. In the former condition hydrochloric acid is alone indicated to induce formation of sufficient pepsin for digestive purposes, and in the latter, as pepsin is inoperative without an acid, it would be useless to employ it. As has already been set forth, he believes that to render it efficient would necessitate the coincident administration of hydrochloric acid in doses too large to be well borne.

[1] As all amylotic ferments are more active in neutral media, the combination of soda with pancreatin is unnecessary when it is given for the purpose of assisting starch digestion. Alkalies should not be used immediately before or during meals in gastric catarrh, for obvious reasons.

complete saccharification of starch, and also, depending upon the amount of trypsin it contains, aids slightly in the digestion of proteids, largely preventing the development of irritating organic acids, of such frequent occurrence through fermentation of starches when the latter are taken without the employment of an artificial digestant. In conditions of complete anacidity, when the use of hydrochloric acid and pepsin could not be beneficial, and in advanced subacidity, when the results of its employment do not justify its continuance, pancreatin may be prescribed after meals with benefit, in combination with soda if the development of sufficient organic acid to impede its action is feared.

Gastralgic attacks, more frequently symptomatic of nervous dyspepsia, chlorosis, or gastric ulcer than of the affection under consideration, are rarely very severe in gastric catarrh, and when they occur are usually due to peripheral irritation of the stomach-nerves by undigested, decomposing food. Their management necessitates, as far as possible, removal of the cause, the administration of morphine, hypodermically or by the mouth, during the attack, if the intensity of the pain demands it. Mustard to the epigastrium should be used, and for the mild attacks or during the intervals of the more severe ones, if the latter frequently occur, a combination of cannabis indica, belladonna, and cocaine is of the greatest service. The use of bismuth subnitrate and zinc oxide is also very beneficial. If these drugs, or others that may be deemed indicated, are given in solution, a few drops of dilute hydrocyanic acid may be added to each dose, and cherry-laurel water used as the excipient. Where a neuralgic element seems especially to underlie the gastralgia, the daily application of galvanism is of the greatest utility, the anode upon the tender epigastrium and the cathode in the left hypochondrium or upon the lower dorsal spines, or the anode may be applied directly to the interior of the stomach—a procedure rarely necessary for the relief of the gastralgia of chronic gastritis.

The state of the bowels must receive the most careful attention in gastric catarrh. The action of lavage in promoting their regularity has already received notice, as has the beneficial effect arising from the coincident administration of saline laxatives, such as Carlsbad water or other forms of purgative salts. Salines are of the greatest benefit, preceded by an occasional dose of a mercurial (calomel or blue mass), in relieving the engorged condition of the portal viscera frequently accompanying the chronic gastritis, heart, and liver disease of drunkards, and frequently present also in mucous gastritis, whatever the cause. A caution is necessary that salines, Carlsbad water, and especially Carlsbad crystalline salt, consist almost entirely of Glauber salt, the effect of which is exerted chiefly on the liver and intestines. These or other salines must not be given in too full doses or too continuously, otherwise the secretory function of the stomach will be eventually lowered rather

than improved. Their use is indicated for briefer periods than the salines—not over two to four weeks, in small doses daily or once in two days, one hour before breakfast. The purgative influence of all laxative waters and salt solutions is most decided when the solution is taken warm. Should a salt, instead of a natural water, be used, if resorted to daily, sufficient only should be taken ($\frac{1}{2}$ to 1 tea-spoonful to $\frac{1}{2}$ pint) to ensure one free evacuation. If Carlsbad water is used, $\frac{1}{2}$ to $\frac{3}{4}$ pint is all that is necessary. When the more purgative waters can be dispensed with, if the regularity of the bowels is not maintained by short courses of the saline waters, by lavage, or by artificial digestants, very small doses of the vegetable aperients may be used daily, such as cascara sagrada, aloes (preferably in the form of aloin), rhubarb, and occasionally podophyllin. The last is especially indicated when both an hepatic stimulant and a cholagogue are desired, and it may be given alone or combined with extract of nux vomica or strychnine sulphate, or a small amount of belladonna or hyoscyamus may be added to obviate griping and to assist the laxative action through its influence over peristalsis. The form of laxative should be frequently varied, as the effect decidedly diminishes with constant use, especially if too large doses are employed; which should always be avoided, since the object in the administration of these laxatives—especially cascara sagrada, which is without a superior in this direction if properly handled—is to induce regularity of the bowels through tonic effect on their muscular coat. The natural vegetable aperients—such fruits as tamarinds, prunes, and figs—may be used in moderation should they agree. Fermentative processes are both prevented and best controlled by careful regulation of the diet, the exclusion of carbohydrates, and the use of systematic daily lavage, preferably without antiseptics, which, though promptly removed by the tube, may tend to cause irritation during their brief stay in the stomach. Lavage with mild, warm, alkaline solutions for the purpose of dissolving and removing mucus, one hour before breakfast, repeated in pronounced cases, if necessary, one hour before the evening meal, or, instead, before retiring, should be continued so long as the symptoms demand it and benefit results from its employment. As amelioration occurs it will be necessary less and less often. When the symptoms soon after a meal indicate decided decomposition which cannot be controlled by the administration of hydrochloric acid, recourse should be had without delay to the tube to empty and clean the stomach. Food-elements should not be allowed to remain and decompose if they can be removed. The catarrhal process is not only much aggravated thereby, but the passage of the products of decomposition into the duodenum is likely to cause a catarrhal condition of this part, resulting in intestinal meteorism, diarrhœa, and more or less icterus, owing to the implication of the ductus communis in the process.

As fermentation in the stomach occurs through diminution of the proper gastric secretion, hydrochloric acid, which strikes at the cause, is the best antifermentative. It should be given after meals, in repeated doses at short intervals, or, as Boas prefers, on an empty stomach. Sodium bicarbonate or other alkalies should be given sparingly, if at all, after meals, for the purpose of correcting the pyrosis of chronic gastritis, which is invariably set up because of diminution in the secretion of hydrochloric acid, since, as Henry justly points out, though the lactic acid, the usual cause of pyrosis, is neutralized and the discomfort lessened for a time, the latter soon returns with redoubled vigor, the increased alkalinity favoring still more the growth of the lactic-acid organism. If a recourse to antiseptics seems desirable to correct gastric and intestinal flatulency, hydronaphthol, bismuth salicylate, and salol are the most efficient remedies. Hydronaphthol, which the writer has used for a number of years in various forms of intestinal disorders originating meteorism, in doses of from 2 to 5 grains, has been of extraordinary benefit in his hands. It may be taken in capsule, ingested with considerable water. Bismuth salicylate, which he has used less, has given satisfactory results, especially when combined with powdered willow charcoal. The dose is 5 grains of the former to 10, 20, or more of the latter. Salol, in 5- to 10-grain doses, is especially serviceable in intestinal flatulency, though I have not found it so efficient as hydronaphthol. Both hydronaphthol and bismuth salicylate, like most agents of this class, have a somewhat retarding effect on gastric digestion, and therefore should not be used too soon after a meal nor repeated too frequently. Thymol is an excellent antifermentative in doses of $\frac{1}{2}$ grain to $1\frac{1}{2}$ grains. It may be prescribed triturated with a very little white sugar, or preferably in a small quantity of alcohol, in which it is soluble.

The presence of anæmia is diminished by hydrochloric acid, but demands also the employment of mild ferruginous preparations, such as iron peptonate, mentioned under Gastric Ulcer, or some of the combinations of iron with the vegetable acids. Arsenic may also be used, preferably in the form of the acid solution, the effect of which is more certain than Fowler's solution, in 2- to 5-drop doses after meals.

Finally, the general hygiene of the patient demands the most careful attention. His life should be spent in the fresh air, and as much muscular exercise taken as the strength will permit. Exercise must not be taken near a meal-time, and should never be persisted in to the point of great fatigue, lest the digestive functions thus be indirectly disturbed. It should consist in the use of the muscles generally, but especially those of the abdomen. Walking and horseback riding are of service. Ewald recommends rowing with a sliding seat. The function of the skin should be maintained by frequent baths, and douches to the abdomen and epigastrium

are serviceable as exciters of peristole and as reflex stimulators of secretion. In all cases of gastritis except the simpler variety, which usually improves rapidly on the treatment indicated, an examination into the gastric functions, especially the secretory, should, if possible, be made at intervals of a month or six weeks, so that if decided subjective benefit is not noticeable, the plan of therapy pursued, if not productive of some perceptible objective results, may be modified or changed, since no time is to be lost in the treatment of the pronounced forms, which, apart from the danger of the development of obstructive or atonic dilatation of the stomach, have a tendency to run into incurable atrophy of the gastric tubules.

Little remains to be said of the management of gastric atrophy, the therapy of which can be but symptomatic. The gastric motility and absorbing powers are always much diminished, and dilatation is apt to exist. Efforts must be made to improve peristole and diminish dilatation by the use of full doses of strychnine, by epigastric and abdominal massage, galvanism, and faradism. The ingestion of fluids should be avoided. Aliment must be predigested, or, when easy of solution, be given with an active pancreatic preparation. In cases with dilatation and pronounced motor insufficiency, with or without pyloric stenosis, gastro-enterostomy offers the only chance against gradual starvation. So long, however, as considerable motor insufficiency and dilatation do not exist and the pylorus remains patulous, a fair nutrition may be maintained for some time by the above means or even through the aid of duodenal digestion alone. As, according to Boas, massage of the right hypochondrium toward the median line and in the region of the right and left lobe of the liver tends to press the intestinal juices from the duodenum through the pylorus, it has been suggested that this procedure be systematically instituted in cases of atrophy, that gastric digestion be thus carried on by aid of the patient's own pancreatic and biliary secretions. This ingenious idea is at least worthy of trial.

SIMPLE ULCER OF THE STOMACH.

It has long been believed that the most prominent factor in the development of simple ulcer of the stomach is a local disturbance in the normal balance existing between the acidity of the gastric secretion and the alkalinity of the stomach-walls, permitting the solvent action of the former on a portion of the mucosa, rendered vulnerable through a variety of causes, these causes originating, as was thought by Virchow and others, in impairment or interference of the circulation in a limited

area of the stomach-wall due to vascular obstruction, thus inducing diminished alkalescence. Though occlusion of the vessels supplying a circumscribed part of the stomach may undoubtedly originate an ulcer, this view, so long dominant through the powerful support of Virchow, has not now many adherents, since such alterations and the causes that induce them are rarely found post-mortem to be associated with ulcer. The more likely cause of simple ulcer of the stomach is that which supposes a disturbed balance between acidity of the gastric secretion and alkalinity of the stomach-walls, due to actual increase of the former, which causes erosion of the part the site of an injury to the mucous membrane—a small abrasion which may have been produced by the ingestion of an irritant, mechanical, thermal, or chemical. This view, which has recently found many supporters for the reason mentioned below, is essentially that of Leube.[1] It is supported by the experiments of Daettwyler[2] on dogs, who produced ulcer of the stomach in the latter simply by the application of chemical, mechanical, and thermal irritants to the inner walls of the stomach. A slight solution of continuity resulting through the action of an ingested irritant might in the predisposed readily develop into an ulcer by the corrosive action of a highly acid gastric juice, perhaps assisted, as suggested by Leube, by the stimulating effect of the latter on the denuded blood-vessels, inducing in such cases, according to Klebs, narrowing of their calibre and local anæmia, which in its turn would cause lessened alkalescence.

Recent observations seem to point to the fact that neurotic disturbances of digestion, with heightened excitability of the secretory nerves, inducing hyperacidity or hypersecretion of the gastric juice, whether idiopathic or secondary to other neuroses, such as hysteria, neurasthenia, and melancholia, are very frequently present in the class of subjects in which ulcer most frequently develops, such as young chlorotic females;[3] and though the researches of Riegel,[4] which led him to the conclusion that hyperacidity may be regarded both as a constant accompaniment of simple ulcer of the stomach and a predisposing cause, have not received entire confirmation at the hands of subsequent investigators, they have at least not suffered sufficient modification to render his conclusion re-

[1] Leube, *op. cit.*, p. 206. [2] Quincke, *Deutsche med. Woch.*, No. 6, p. 79, 1882.

[3] Hyperacidity exists so commonly in those in whom ulcer most often occurs, and has been found so constantly with it, that when it is considered how easily excessively acid gastric juice might lead to ulcer, other conditions, such as anæmia and a slight abrasion of the mucosa caused by an ingested irritant, being favorable, I think it may be looked upon as a determining factor in most cases. When hyperacidity is not found its absence is probably due to the existence of a chronic gastritis, which frequently complicates ulcer, the tendency of which must be to lower secretory activity.

[4] Riegel (*Zeitschr. f. klin. Med.*, 1887, xii. p. 434) showed, as a result of 382 analyses of the stomach-contents in 42 cases of ulcer of the stomach, that free hydrochloric acid is almost invariably increased, and frequently decidedly so (the percentages 0.4 and 0.5 being common in his cases), as against the normal 0.1 to 0.2 per cent.

garding the influence of increased secretion of hydrochloric acid on the development of ulcer invalid. For this condition of heightened secretory activity is too common in ulcer not to be regarded as an important determining factor. Notwithstanding the observations of Cahn, Mehring, and others, that hyperacidity is not constantly associated with ulcer, Riegel's conclusions, based on numerous examinations in many cases, seem sufficiently well founded to be regarded at least as highly significant and worthy of most careful consideration from the standpoint of prophylaxis. For, apart from the evil influence of hyperacidity (with or without hypersecretion [1]) on the gastric saccharification of starch and on duodenal digestion, and apart from the fact that hypersecretion may ultimately cause atonic dilatation and gastric catarrh, the likelihood that ulcer may develop through the occurrence of a slight injury to the mucous membrane of the stomach in subjects with hyperacidity should lead to the institution of active measures to remove this condition in all such cases that come under observation. Especially would this be necessary were these the subject of anæmia. For, as is well known, ulcer is most common in the anæmic as a result, rather than as a cause, of the impoverished blood; which fact is significant in view of the experiments of Daettwyler, who found that when dogs were rendered anæmic by frequent bleeding gastric ulcer developed from much slighter irritants applied to the inner stomach-walls than when depletion was not practised, and that these ulcers healed more slowly.

Hyperacidity necessitates correction of the condition underlying it, and the administration of an alkali, both for the purpose of completely neutralizing acidity, thus obviating the danger of corrosion of the stomach-walls, and also to allay sensory and motor irritability, so frequently present in these cases as a result of the action of the excessively acid gastric secretion on the sensory nerves. The alkali must be given in full doses, about four hours after a meal, at the completion of gastric digestion, or even earlier should the discomfort caused by the hyperacidity be excessive, and again, perhaps, shortly before a meal, at the time first mentioned. The purpose is served not only of obviating the irritant effect of the excessively acid secretion on the gastric mucosa after the food has passed the pylorus, but also of preventing its inhibiting influence on the duodenal digestion of carbohydrates and fats, always imperfect in cases of hyperacidity. If the acidity is excessive, the alkali may be used shortly before a meal, thus permitting the partial stomach digestion of starches, impossible through the too early appearance of free hydrochloric acid. Any active alkali or alkaline earth not of too disagreeable taste may be used. The alkalies in common use are

[1] Hyperacidity often exists without hypersecretion, while the latter usually is accompanied by the former.

sodium bicarbonate, precipitated chalk, calcined magnesia, ammonio-magnesium phosphate, and magnesium carbonate, any one of which is efficient. Sodium bicarbonate is most often resorted to as a neutralizer of acidity. Apart from its disagreeable soapy taste, to which many object, especially when taken in the form of the otherwise convenient and efficient soda-mint tablet, its antacid potency is lower than any of the others mentioned, several of which, especially the ammonio-magnesium phosphate,[1] are to be preferred because of their tastelessness.[2]

As suggested by Roberts,[3] the alkalies are to be used preferably in the form of lozenge, which should be allowed to dissolve slowly in the mouth. A plentiful flow of alkaline saliva will be thus induced, which, gradually swallowed, acts both as an antacid and as a bland demulcent to the angry mucous membrane.[4]

Hyperacidity accompanying hypersecretion requires not only the frequently repeated use of alkalies, but also systematic lavage, either shortly before a meal or at the completion of its stomach digestion. Reichmann recommends the employment of silver nitrate in these cases, either in the form of a wash, 1 part to 500 or 1000, or ½ grain to 1 grain in 10 drops of water and enclosed in a capsule. The diet must be dry and chiefly albuminous, to make use of the excessive secretion of gastric juice. A systematic use of antacids for a prolonged period in the manner indicated, combined with the employment of alkaline purgatives, the indications for which will be presently mentioned, will eventually, in most cases, lower secretory activity, especially if an effort is made to reach the cause of the disturbance. Alkalies must, however, be used with discretion, and they should never be taken in sufficient

[1] According to Boas, *op. cit.*, p. 250.

[2] The saturating power of magnesia compared with sodium bicarbonate is as 4 to 1; that of ammonio-magnesium phosphate, 2 to 1; magnesium carbonate, creta precipitata, slightly less than 2 to 1. A full antacid dose of sodium bicarbonate is 10 to 20 grains; that of the others in proportionate amounts. (See Boas, *op. cit.*, p. 250; Roberts, *op. cit.*, p. 255.)

[3] An antacid lozenge made after his formula is now sold in the shops; it is much preferable to the soda-mint troche. It contains 3½ grains magnesium carbonate and 2½ grains of chalk, these quantities equalling in saturating power 10 grains of sodium bicarbonate. Roberts recommends that 1 grain of common salt be added to the tablet to increase salivary flow.

[4] Roberts, *op. cit.*, p. 251. Roberts states that he has ascertained that a direct relationship exists between the acidity of the gastric juice and the alkalinity of the saliva, so that during the prevalence of surplus acid in the stomach an increased flow of highly alkaline saliva occurs, which is involuntarily swallowed and becomes the natural antacid of the stomach. This increased salivation he regards as a conservatism of nature to be encouraged by the use of any agent promoting salivary flow. Lozenges do this, and especially simple gum lozenges. With these gum lozenges, because of their stimulating effect on the salivary glands and the soothing influence of the swallowed gum on the irritated mucosa, he has obtained distinctly more curative results than by the use of alkalies, which he resorts to only if the surplus acid is great and the torment severe.

doses to completely neutralize acidity during digestion, lest a catarrhal gastritis with subacidity result, more difficult of removal than the preceding heightened physiological condition. Care must be taken to prevent the development of anæmia. The diet in these cases, apart from its influence on secretion, must be bland and unirritating; indigestible substances likely to irritate the stomach mechanically, spices, acid food, or drinks of very high or low temperature, are to be avoided.

The one essential indication in the therapy of gastric ulcer, in comparison with which the use of drugs formerly supposed to exert a more or less specific influence is as naught, and with which their employment is unnecessary, is to lessen the functioning of the stomach, as far as it is practicable with the maintenance of a fair nutrition, by a diet that will stimulate it to activity as little as possible, and by the exclusive use of rectal feeding for short periods when there are present such symptoms as hæmorrhage, severe and continuous pain, and vomiting, suggesting the advancement of the ulcerative process. From the first, and continuously so long as the symptoms indicate that complete cicatrization has not occurred, the diet should consist of partially or wholly predigested concentrated aliment, the solution and transfer of which into the duodenum will disturb the stomach mechanically and chemically as little as possible. Concentrated aliment that affords considerable nutriment in small bulk is especially indicated, both for the purpose of diminishing the work of the stomach and for the reason mentioned by Yeo,[1] that this viscus be maintained in a contracted state, so that the margins of the ulcer be thus constantly relaxed. By this means its extent will be lessened and its healing favored. Rest in bed in all cases in which the symptoms are well marked and nutrition is depressed is also essential; with it less nourishment is required, that taken is better borne, and cicatrization is more readily favored than if the patient is permitted to be about. The food best suited for cases of gastric ulcer, and which, properly prepared, usually can be made to agree despite supposed idiosyncrasy, is milk, the diet which, since first recommended by Cruveilhier, has been used successfully in thousands of cases.[2] It should be taken in small quantities (from 4 to 6 ounces[3]), skimmed or not, boiled or raw, as it agrees, at intervals of two or three hours, and should preferably be rendered alkaline if it is not peptonized; otherwise the large tough coagula occurring in its digestion in its natural condition in the highly acid stomach will surely disagree. Saccharate of lime contains five times as much lime as does lime-water, and may well replace the latter. Precipitated magnesium

[1] Yeo, *Food in Health and Disease*, p. 389.

[2] Leube, *op. cit.*, p. 219.

[3] Or less and oftener if the stomach be very irritable. About three pints must be taken in the twenty-four hours if milk alone be used.

hydrate (milk of magnesia), recommended by Smith as an antacid in ulcer, should also be very efficient.

Peptonized milk, and preferably peptonized milk-gruel, are especially indicated where decided gastric irritability exists and severe paroxysmal pain occurs after food; they can well replace simple alkalinized milk at all times. In their preparation peptonization should not be carried beyond the point of faint bitterness;[1] if the latter taste is objectionable, as it usually is,[2] when the case is progressing favorably their use may be varied with other light aliment, that the palate be not satiated by sameness, though if peptonized milk-gruel is not much wearied of, and the patient seems to thrive on it, it had better be continued as long as possible. Indeed, the same may be said of any form of diet that agrees. Peptonized milk-gruel, however, seems to be of especial value in gastric ulcer. Roberts commends it in the highest terms. He regards it especially indicated in cases associated with epigastric pain. In one case which he details gastric irritation was such that the simplest nourishment given in smallest quantity was immediately rejected. Peptonized milk-gruel was tolerated at once; vomiting occurred only once or twice during the first two days of the treatment, and then ceased, as did likewise epigastric pain. The patient took daily 2 or 3 quarts of the peptonized milk-gruel for a period of six weeks, no other form of nourishment being used; steady recovery of flesh and strength occurred. Ice-cream has recently been suggested, and seemingly with reason, as an efficient food in gastric ulcer. Hershey reports three cases in which the simplest aliment by the mouth, such as alkalinized as well as peptonized milk, was not retained, and in one of which predigested enemata were likewise rejected. In all, on other food being discontinued and ice-cream permitted, digestive disturbances ameliorated and rapid improvement occurred. The employment of this singular diet was suggested by its influence on the first of the cases seen in the clinic of Dr. DaCosta. This patient had herself resorted to ice-cream on discovering that no disturbance of the stomach occurred through its ingestion. Its continuance for this reason was advised by Professor DaCosta, with the happiest effects, similar results being obtained in the others. These results justify its further trial in ulcer.

Ewald recommends soups made of milk and various forms of flour,

[1] Yeo (*loc. cit.*) advises the addition to each cup of milk of a powder containing 10 grains each of sodium bicarbonate and common salt, 5 grains of light magnesia, and 1 table-spoonful of water.

[2] The addition of Vichy, soda, Apollinaris, and other carbonated waters is recommended to overcome the bitterness, which, however, is hardly perceptible in the gruel. Aërated waters must, however, be used sparingly, if at all, in ulcer, because of the irritant effect of the free CO_2 on the ulcerated surface. A small quantity of coffee entirely masks the bitter taste, according to Smith (*Med. News*, May 17, 1890).

the latter added, as are alkalies, to induce finer coagulation of the casein. The addition of a small quantity of one of the predigested and nutritious infants' foods, such as Mellin's, Carnrick's, or Nestlé's, has a similar effect. Potato purée (made with milk) usually agrees well, especially if a good preparation of malt is taken with it.

When milk is wearied of, though prepared so as to be least objectionable, and the patient's condition does not improve,[1] as may happen through adequate nutrition not being maintained with it, a predigested beef-solution, similar to that devised by Rosenthal and Leube,[2] should be resorted to, or may, indeed, be used from the first with the best results. Leube's experience in the treatment of gastric ulcer is extensive and highly successful, and, though he places a high value on milk in this ailment, his results have been far more gratifying with this meat-preparation. Leube regards the beef-solution as especially valuable, as its constituents are ready for absorption without any particular action of the gastric juice, so that secretion of the latter is little stimulated. He believes that this preparation is either directly absorbed from the stomach or passes unchanged into the duodenum. As it is without irritant quality and makes but slight demand on the digestive functions, the diseased viscus is rested, and the ulcerated surface, freed from constant irritation, is placed in a condition favorable to cicatrization. Leube's experience is that with it rectal feeding is usually unnecessary; after a few days' use pain and vomiting, if present, usually cease, and the healing advances so rapidly that at the expiration of two or three weeks the patient may return with impunity to a more solid diet.[3]

Leube gives this beef-preparation in either unsalted or very slightly salted broth, and an amount corresponding to half a pound of beef is taken in the twenty-four hours. Unfortunately, patients are apt to acquire such a disgust for it that they often cannot be persuaded to continue it. It possesses no advantages over other predigested beef-foods, and indeed is, theoretically at least, less valuable than some—notably Mosquera's beef-meal and beef-peptone jelly, previously re-

[1] Nutritive enemata may be required to supplement the use of peptonized milk by the mouth when the latter only can be taken and in small quantity.

[2] This is prepared by evaporating beef and dilute hydrochloric acid at a high temperature in air-tight vessels, which leads to the emulsification of the meat and its partial digestion: 1000 grammes of finely-minced lean beef, 1000 centigrammes of water, and 20 centigrammes of pure hydrochloric acid are placed in a porcelain vessel, and this in a closed Papin's digester, and boiled for ten to fifteen hours. The resulting mass is then rubbed into a paste in a mortar, again boiled in the closed digester for sixteen to twenty hours, and finally neutralized with sodium bicarbonate and evaporated to a syrupy consistence. This preparation is made by Rudisch of New York City. Though peptones are said by Leube to be formed by this process, it is unlikely that digestion proceeds beyond the acid-albumin, or at most the first propeptone, stage.

[3] Leube, *op. cit.*, p. 223.

ferred to, which represents, according to the analysis of Ludwig of Vienna, over 53 per cent. of soluble albuminoids, which have been almost entirely converted into peptones, and the whole containing but 3 per cent. of insoluble matter. Preparations of this sort, when a concentrated peptonized soluble meat-food is desired, are to be preferred to one only partly digested by hydrochloric acid. With the beef-meal I have had no experience in ulcer. It contains considerable insoluble albuminoids but slightly if at all digested. This insoluble portion, though probably readily converted into peptone in the stomach, according to Chittenden, might irritate the ulcerated surface if it were not. Mosquera's beef-jelly may be dissolved in boiling water, or preferably added to consommé; a yelk of an egg may also occasionally be given with it prepared in the manner detailed in the dietary of Chronic Gastritis. Though the beef-jelly should be added to boiling water or to broth at or near the boiling-point, it, as with other foods in gastric ulcer, must not be taken very hot.

It is of the highest importance that the diet be thus restricted for several weeks, until continued amelioration in or absence of such symptoms as severe pain, gastralgic or inflammatory epigastric tenderness, and vomiting indicates that cicatrization of the ulcer is in progress. Then in all except the chronic cases a more varied alimentation may be cautiously permitted, the patient being especially admonished as to the danger of reawakening the ulcerating process by the slightest lapse from the diet prescribed, the utmost circumspection on his part being enjoined for months after all symptoms of ulcer have disappeared. Care should be observed not only as regards quality, but also as to the quantity taken, no more being allowed than will satisfy the physiological needs of the body. An egg may be allowed daily lightly boiled or poached, but not raw, since raw egg-albumin is digested with difficulty both in the stomach and duodenum.[1] With the boiled or poached egg, crumbs from the interior of stale bread, flavored with a very little salt, may be eaten, and meat-broths, such as chicken and mutton-broths, if they have not been before used, may now be prepared with yelk of egg to render them more nourishing. Purées of vegetables, milk-puddings, custards, the lean of tender boiled mutton or young chicken, the scraped tenderloin of steak lightly broiled with

[1] The indigestibility of raw egg-albumin is shown by an interesting experiment of Roberts. He employs a solution of the white of 1 raw egg to 9 volumes of water. This, when heated in the water-bath, does not coagulate nor change in appearance, though its behavior to the digestive ferment is distinctly altered. In the raw state this solution is attacked slowly by pepsin and hydrochloric acid, and not at all by pancreatic extract; but after cooking in the water-bath the albumin is rapidly and entirely digested by artificial gastric juice, and a moiety of it is rapidly digested by pancreatic extract.

a little butter,[1] boiled sweetbread (the thymus gland), boiled whitefish, and such other wholesome digestible articles of food as the judgment of the physician dictates, may be permitted in moderation. He cannot throw, within practicable limits, too great restrictions about the diet, nor advise too much caution for several months after all symptoms have disappeared, having in mind, however, the necessity of allowing sufficient nourishment to maintain adequate nutrition. Indigestible food of all sorts, especially that likely to irritate the stomach mechanically, such as bran bread and oatmeal, is to be avoided. Fatty substances, acids, highly-seasoned foods, and alcohol in any form must also be interdicted.

Rectal feeding is to be resorted to for periods of a few days or longer on the occurrence of hæmatemesis, when more or less continuous vomiting or severe paroxysmal pain after meals is not readily controlled by cautious mouth-feeding or by the remedies suggested. In all cases of ulcer, if the patient can be kept in bed and will submit to exclusive rectal feeding, the stomach remaining at absolute rest, cicatrization is likely to occur earlier with fewer untoward symptoms than if this method were not practised. Though, according to Bauer, it is impossible to nourish properly by the rectum, scarcely more than one-quarter of the nutriment necessary for subsistence being taken in this way, extensive clinical experience has shown that exclusive rectal feeding for periods of several weeks is practicable in ulcer and attended with the best results. If nutrient enemata are to be employed for any time, it is especially important that the substance used be as unirritating as possible. The rectum should be washed out with a warm-water enema once or twice daily shortly before introducing the food. The syringe for the administration of nutritive injections should have a long flexible nozzle, and the food be deposited high in the bowel, both to include a wide absorptive area and that it may be better retained.[2] The nozzle should be well oiled, and must be inserted gently, without force, and the food be very slowly thrown into the bowel. The patient may be encouraged to aid its retention as much as possible by resisting any desire to reject it. Not over 4 ounces is usually injected at a time, the frequency of repetition depending upon the amount and the character of the nourishment introduced. Intervals of from four to six hours are those usually adopted, when from 4 to 6 ounces are used. As regards the character of aliment best adapted for nutrient enemata, liquids are preferable to solids, such as suppositories, especially in ulcer,

[1] Welsh, Pepper's *System of Med.*, vol. ii. p. 320.

[2] According to Brunton (*Pharmacology and Therapeutics*, Lea Bros., 1885, p. 415), if a long flexible soft-rubber tube is used, introduced to the extent of ten inches, and the patient is propped so as to incline to the left side, the fluid may be passed into the sigmoid flexure or descending colon. A much larger quantity than four ounces can then be used and absorbed with little or no tendency to its rejection.

when the withholding of all fluids by the mouth is desirable. Soluble unpeptonized albumin would appear to undergo absorption almost as readily as that which is predigested, so that predigested aliment need not necessarily be used.

Ewald,[1] as a result of experimentation with enemata of commercial peptone and with eggs, found that unpeptonized eggs were as readily absorbed as commercial peptone, and peptonized eggs more readily. He prefers an enema consisting of two eggs beaten up with a table-spoonful of cold water, to which is added a little starch boiled with a half tea-cupful of a 20 per cent. solution of glucose. A wine-glassful of claret is added to this, and subsequently the egg solution, care being taken that the white of egg is not coagulated. A tea-spoonful of peptone may be added with advantage to this mixture, though Ewald does not regard this as absolutely essential.

If solutions of peptones alone are used, they should be sufficiently diluted not to irritate the bowel, otherwise they will not be readily retained. According to the experience of Smith,[2] the best rectal food is defibrinated blood in amounts of 3 ounces every fourth hour when no food is taken by the stomach. This, he states, undergoes prompt absorption, as is shown by the character of the dejecta during the treatment. These are of a normal color, and absolutely free from all appearances of blood. Smith uses rectal injections of defibrinated blood in all cases of hæmatemesis, continuing it in small quantities for two or three weeks after the stomach has resumed its functions. He knows of no remedy equally efficacious in overcoming the profound anæmia usually present. Leube prefers for nutrient enemata an emulsion of meat and pancreas. But pancreatic extracts, of which several very active preparations are now on the market, are much more convenient for use than the pancreas itself, and quite as efficient. The enema as suggested by Roberts may be prepared in the usual way with milk-gruel and beef-tea, and a dessert-spoonful of liquor pancreaticus added just prior to its administration.

Plain milk, or preferably peptonized milk and peptonized milk-gruel, are well adapted for nutrient enemata.[3]

The enemata should always be warmed before introduction. Sometimes the addition of a small quantity of opium, preferably the deodorized tincture or McMunn's elixir, to the enema renders it better borne.

[1] Ewald, *Therapeut. Monatsh.*, March and April, 1887.

[2] Smith, *loc. cit.*

[3] Roberts nourished a patient by this method with enemata of pancreatized milk-gruel exclusively, and very satisfactorily, for a period of nine weeks, until a post-pharyngeal abscess, which had occluded the œsophagus, ruptured. Donkin (*Lancet*, Sept. 27, 1890) reports ten cases of gastric ulcer successfully treated by enemata of plain milk, occasionally varied by clysters of beef-tea. Three of these cases were so nourished, exclusively, for nineteen days.

Cases are occasionally encountered in which both stomach and rectum become rebellious, rejecting all that is introduced in the ordinary way. In these, feeding by the soft stomach-tube should be resorted to after the plan of Debove, who uses the stomach-tube very extensively in feeding cases of gastric ulcer. Nourishment is often well borne in this way that would be at once rejected if swallowed. In gavage it is unnecessary to pass the tube into the stomach, so that little risk can result from its use if its employment does not cause violent retching. The latter may be obviated by the use of cocaine in the manner already described.

The medicinal treatment of gastric ulcer is entirely symptomatic, as we are still unacquainted with any specific for this affection. Silver nitrate and oxide, bismuth subnitrate, and zinc oxide still have their advocates, though on entirely empirical grounds. Their effect, if any is exerted in promoting cicatrization of the ulcer, must be slight and entirely indirect, perhaps through their influence on the disturbed secretory function and on an accompanying gastritis. Silver salts, as stated by Leube, can scarcely act by virtue of their caustic properties, since it is most improbable that the dose ordinarily administered, which must necessarily be small, can seek out from the whole surface of the stomach the ulcerated spot and deposit itself there. Partially to overcome this objection, and with faith in its direct curative effects on the ulcer, Smith[1] very ingeniously recommends that silver nitrate be given in $\frac{1}{4}$- to $\frac{1}{2}$-grain doses dissolved in an ounce of water, and administered while the patient is lying on the right side, so as to bring the solution into contact with the ulcer if situated in its usual position near the pylorus. Silver nitrate is so readily decomposed, and hyperacidity is so common in ulcer, that it is more than probable that the insoluble chloride is formed on the entrance of the nitrate into the stomach, except in those cases in which acidity is lessened or much albumin or peptone is present; and when the latter is the case the salt would be too much diluted to exert any local effect. As the chloride, because of its insolubility in the stomach, is practically inert, it would appear useless to administer silver, even in the mode suggested by Smith, in cases with hyperacidity; and yet it is in this same class of cases that the employment of silver has its warmest advocates, it being supposed, in some undiscovered manner, to diminish the excretion of a too highly acid gastric juice and thus lessen pain. In the more chronic ulcers with thickened, indurated edges and great depth and extent, in which healing is tardy under the most favorable treatment, and in which hyperacidity is replaced by subacidity due to the development of gastric catarrh, little benefit could result from the use of silver nitrate, even if applied directly to the lesion in the largest dose compatible with safety. What-

[1] *Loc. cit.*

ever benefit resulted would be through its influence on the associated catarrhal condition. Bismuth, too, and zinc oxide—the former of which has been in use for over a century in gastric disorders, especially in ulcer and in gastralgia—can have but little directly curative effect on the ulcer, even when given in the enormous doses (upward of half an ounce) frequently used by the French. The influence of these drugs, like silver, is exerted chiefly in a symptomatic direction. The condition of hyperacidity is advantageously met by the administration of small, frequently-repeated doses of some of the alkalies mentioned. One of the best is that recommended by Smith—precipitated magnesium hydrate ("milk of magnesia"). This preparation is unirritating and has high neutralizing power. It has the appearance and somewhat the taste of milk, and may for that reason be well administered in that liquid. It is preferable to the alkaline carbonates in ulcer, as the evolution of carbonic dioxide in the stomach is avoided. When hypersecretion accompanies hyperacidity, it may be necessary to resort to lavage with the soft black rubber stomach-tube, the use of which is free from risk if not introduced too soon after a hæmorrhage or unless violent retching and vomiting are caused by it. Patients who submit to its employment are usually so markedly benefited as regards amelioration or cessation of pyrosis, gastralgia, and vomiting when due to hyperacidity that they desire to continue its use. As a rule, however, its employment is easier in hospital than in private practice.

The old-fashioned Carlsbad crystalline salt, the use of which was first advocated by Ziemssen, is of the greatest utility in ulcer as an antacid and also as a laxative. In the dose recommended by Ziemssen it neutralizes acidity, cleanses the ulcerated surface, and by its effect on the gastric peristole removes stagnant irritating ingesta. This crystalline salt, the chief ingredients of which are sodium sulphate and carbonate, the former in large excess,[1] cannot be efficiently replaced by Carlsbad water or artificial Carlsbad salts containing sodium chloride in any amount, as advocated by Welsh,[2] following Liechtenstein, except in ulcer complicated by gastric catarrh with subacidity, because of the stimulating effect of sodium chloride on gastric secretion and its irritant action on the ulcerated surface.

[1] Its composition is sodium sulphate, 37.69; sodium chloride, 0.39; sodium carbonate, 6; potassium sulphate, traces; water of crystallization, 55.52. This must not be confounded with the Carlsbad salt in powder form, which contains considerable quantities of sodium bicarbonate and chloride. Both of these salts, bottled in Carlsbad, may be procured from any druggist or direct from the importers, the Elsner & Mendelson Co. of New York. They can, of course, be prepared artificially, especially the crystalline salt.

[2] Welsh (Pepper's *System of Medicine*, vol. ii. p. 523) recommends a combination of sodium sulphate, 5 ounces; sodium bicarbonate, 2 ounces; and sodium chloride, 1 ounce. One to two heaping tea-spoonfuls of this, the dose given, would contain from 12 to 24 grains of common salt.

Ziemssen's method of administration gives the most satisfactory result:[1] A table-spoonful is dissolved in a pint of lukewarm water, and one-fourth is taken every ten minutes, half an hour elapsing between the last dose and the morning meal. If the bowels are moved more than twice or not at all, the quantity of salts taken next day must be regulated accordingly, but the amount of water in which the salt is dissolved should be the same.

Pain in gastric ulcer, especially the continuous dull localized pain, with sharp exacerbations appearing shortly after eating, indicating irritation of the nerve-filaments in the floor of the ulcer, is best relieved by either total withdrawal of feeding by the mouth for a few days, rectal alimentation being substituted, or the use of an absolute milk or peptonized milk-gruel diet. Opium or its derivatives should be resorted to rarely if at all, unless the pain is very intense, until the influence of careful feeding has been tried, not only because of the risk of establishing the opium habit, but because the relief obtained by this drug is apt to render the patient less cautious as to diet. If an opiate seem indicated, morphine is preferable to opium itself. It may be used hypodermically if prompt relief is required, or may be given by the mouth, combined with dilute hydrocyanic acid or perhaps with bismuth or other of the drugs mentioned for the relief of gastralgia. Should the pain be localized in the anterior stomach-walls, the application of a small blister or an ice-bag or hot fomentations, if the patient can be confined to bed, will often relieve it. Decubitus is frequently essential to other means for the relief of pain, the latter not decidedly ameliorating until rest in recumbency, supine, prone, or on one side, is tried.[2]

The diffuse paroxysmal gastralgic attacks which are very common and often very severe in ulcer are usually due to radiation of the irritation caused by the implication of sensitive nerves in the ulcerative process, and also by contact of the hyperacid gastric juice with the exposed nerve-filaments in the floor of the ulcer; or gastralgia may be caused by the irritating effect of the acid secretion on the hypersensitive stomach-nerves without implication of the latter in the ulceration. If the circumscribed, continuous, dull pain, with paroxysmal exacerbations soon after eating, is associated with gastralgia, though the same association occurs less commonly in the gastralgia of hyperacidity, a diet of milk or peptonized milk-gruel or similar food should be resorted to. In gastralgia of hyperacidity, alkalies com-

[1] Quoted by Leube, *op. cit.*, p. 222.

[2] Pain is sometimes assuaged by the assumption of a special posture, the relief being most decided after a meal: the influence of posture on the former was thought by Osborne (*Dublin Journal Med. Science*, xxvii. p. 25, 1885, quoted by Welsh) to indicate the locality of the ulcer—relief in the prone position suggesting ulcer of the posterior wall; in the supine position, ulcer of the anterior wall; on the right or left side, ulcer of the pyloric or cardiac region, respectively.

bined with bismuth subnitrate and very small doses of morphine, if the urgency of the pain demands the latter, may be tried. A powder containing 3 to 5 grains of magnesia, 5 to 10 of bismuth subnitrate, and $\frac{1}{16}$ to $\frac{1}{12}$ of morphine sulphate is useful, repeated at hourly intervals, if necessary, until three or four doses are taken. Cannabis indica[1] ($\frac{1}{8}$ to $\frac{1}{3}$ grain of the extract), cocaine muriate ($\frac{1}{12}$ to $\frac{1}{3}$ grain), and belladonna ($\frac{1}{12}$ to $\frac{1}{4}$ grain of the extract), used singly or combined with each other, with bismuth, an alkali, or with dilute hydrocyanic acid, often relieve the gastralgias of ulcer.

Gastralgia not dissipated by the means suggested may occasionally continue after complete healing of the ulcer. It is then probably due to compression of nerve-filaments in the cicatricial tissue of the ulcer, and, unfortunately, is not susceptible of cure by medical means. Flatulent distension of the stomach is sometimes a cause of pain. A few drops of Hoffman's anodyne with mint-water will cause expulsion of the gas. If acidity is present, an antacid, preferably not a carbonate, may be also administered. Charcoal, the power of which to absorb gases in the moist state is supposed to be *nil*, will often relieve flatulence.

Vomiting, especially that due to implication of some of the gastric nerve-filaments in the ulcerative process, is often not controlled till rectal feeding for short intervals replaces that by the mouth. When vomiting occurs and shows a tendency to persist, rest in recumbency is necessary. All food must be withheld save iced milk, peptonized or plain, or peptonized milk-gruel in very small quantities, a tea-spoonful or two at a time. Pellets of ice may be given or very small quantities of one of the carbonated waters, iced, or a not over-dry iced champagne may be tried. Morphine sometimes gives relief, preferably administered hypodermically. The combination of bismuth, carbolic acid, and mint-water previously mentioned is sometimes efficient. An ice-bag, a sinapism, or a small blister to the epigastrium may have to be resorted to—the first two early, the blister after exhausting other means. A brief unsuccessful trial of milk or milk-gruel demands resort to rectal feeding for a period of three or four days, the stomach being allowed a complete rest. Feeding by the mouth is then cautiously renewed, peptonized milk-gruel or peptonized milk, at first in tea-spoonful doses only at very short intervals, being alone used while a tendency to vomit continues.

The occurrence of hæmorrhage from the stomach necessitates absolute rest in recumbency, preferably perhaps on the left side, as recom-

[1] Cannabis indica has been recently highly lauded by G. Sée (*Lancet*, Aug. 2, Sept. 13 and 20, 1890) as a gastric sedative in the pain of neurotic and gastric dyspepsia. When the former is accompanied by hyperacidity he gives cannabis indica with large doses of sodium bicarbonate four hours after meals.

mended by Smith,[1] that gravitation may assist in the arrest of the bleeding, and that the contents of the stomach may be removed from the ulcer should this be situated near the pylorus. Pellets of ice, the most efficient hæmostatic, should be freely swallowed, a light ice-bag laid on the epigastrium, and heat applied to the legs and feet if the extremities are cold.[2] A hypodermic injection of $\frac{1}{6}$ to $\frac{1}{4}$ grain of morphine sulphate is indicated as a vascular sedative and for the purpose of allaying the patient's nervous apprehensions, which indirectly may tend to increase the hæmorrhage through its disturbing influence on the heart's action. Efforts should also be made to diminish by reassuring words the alarm felt by the patient and those about him, and the utmost quiet on the part of the latter must be insisted upon. Leube suggests that the bed-chamber be kept cool and the bed-covering light, in order not to increase the uneasiness of the patient by interfering with respiration.

The utility of ergot in gastrorrhagia is questionable, and, despite the fact that it is generally recommended, the supposed results obtained by its use are probably of the *post-hoc* order. Hæmatemesis in ulcer, if at all profuse, is due to the perforation of an artery, and not to capillary oozing, a frequent cause of the gastrorrhagia of hepatic cirrhosis. When the result of rupture of capillaries or arterioles, the employment of ergot would be beneficial were not its use unnecessary—the bleeding usually ceasing without it. But when the hæmorrhage is due to the opening of an artery, the usual cause of the copious bleeding in ulcer, ergot is positively contraindicated, as pointed out by Smith;[3] for, because of the constricting action of this drug on the vessels being confined to the arterioles, obstruction of the collateral circulation, with increased tension *a fronté*, must occur, which would directly tend to augment the hæmorrhage.

The employment of such hæmostatics as iron, tannin, lead, alum, sulphuric acid, turpentine, and the like need only be mentioned to be condemned. They are not merely valueless in controlling the hæmatemesis of ulcer, given in the only manner in which their administration is practicable, but are provocative of harm by the gastric disturbance their ingestion is likely to incite. The best hæmostatic is ice, the use of which has been already mentioned. The extraordinary suggestion of tamponing the stomach by the introduction of a collapsed

[1] Smith (*loc. cit.*) suggests that as the gastric artery runs from left to right along the lesser curvature, advantage should be taken of the influence of gravitation in the arrest of hæmorrhage, supposing the ulcer is situated near the pylorus.

[2] Drinking very hot water has recently been recommended in gastrorrhagia as an efficient hæmostatic. It is questionable if it can be as efficient as ice swallowed undissolved. The temperature of the water taken would soon be diminished to that just sufficiently warm to dissolve the coagulum at the site of the ruptured vessels.

[3] A. H. Smith, *op. cit.*, p. 529.

rubber balloon through a tube and subsequently inflating it with air, or that of passing a rubber bag into the stomach and filling it with water, with the idea of thus controlling gastric hæmorrhage, is scarce worthy of notice. Apart from the danger of tearing the ulcerated surface or rupturing the stomach when the bag is filled to a sufficient capacity to check bleeding mechanically, the use of such a remedy would scarcely be practicable even within the confines of a Continental hospital.

A still more impracticable suggestion for checking hæmatemesis not readily controlled by medical means is that of Rydygier,[1] who advocates the performance of gastrotomy with the object of excising the ulcer; but the impossibility of accurately locating its situation would alone render this proposition scarce worthy of serious consideration.

Syncope favors cessation of gastric hæmorrhage through diminution in the force of the heart's action, promoting formation of a thrombosis in and about the bleeding vessel. No great effort, therefore, should be made to prevent its occurrence or to overcome it immediately, unless a fatal termination seems imminent through the resulting cerebral anæmia. The patient, if not already in recumbency, should be so placed. By supplying the brain with more blood this position alone, without medication, will often promote a prompt return to consciousness. Alcoholic stimulants must be given cautiously if at all, and never by the stomach. Nitro-glycerin (1 minim of a 1 per cent. alcoholic solution) in a syringeful of ether or in water may be administered subcutaneously, and usually with immediate beneficial result if unconsciousness is profound and prolonged.

Transfusion is indicated immediately after the occurrence of hæmatemesis only when it seems probable that the patient will succumb from the failure of circulation, experience having shown that the increased vascular pressure resulting from transfusion is likely to occasion renewed and perhaps fatal hæmorrhage by leading to the dislodgment of the thrombus blocking the opened vessel. For this reason, the imminence of a fatal termination demanding some such interference, the risk must be taken, but only the smallest amount of fluid should be introduced which is capable of tiding over the dangerous period, and this must be injected very slowly under low pressure. These precautions are less necessary if transfusion is demanded because of the acute anæmia a few days subsequent to the hæmorrhage, when its recurrence seems unlikely. Here a larger amount may be introduced with but little risk.[2]

[1] *Berliner klin. Woch.*, Jan. 16, 1882.

[2] The only risk then being perforation by the suddenly raised pressure, if a diseased vessel in the ulcer is on the point of rupture.

In either event, if transfusion is demanded, the infusion into a vein of a saline solution should be preferred to the introduction of blood. The latter in recent years has been almost entirely replaced by the former, saline solutions practically fulfilling better than blood all the conditions, physical and hæmogenic, to meet which transfusion is undertaken, besides being far safer and easier of application.[1] A $\frac{3}{4}$ per cent. solution of common salt—about a drachm to the pint—is the most convenient.[2] Not over a half or three-quarters of a pint should be introduced at first. When a recurrence of the hæmorrhage is feared, more can be used later should the urgency of the symptoms again demand it. The solution should be made with boiled, preferably distilled, water. It must be of the body-temperature, and is readily introduced, all that is required being a small glass canula, a piece of rubber tubing, and a funnel. The fluid might be injected into the cellular tissue, preferably between the scapulæ,[3] in place of a vein. The resulting benefit would be as great, though not so promptly produced, and the danger, that of sudden raising of vascular tension, would be largely obviated.

No food should be given by the mouth during hæmorrhage or for several days subsequently if it can possibly be avoided. The patient should be nourished by the rectum in the manner indicated. Should the latter be absolutely impracticable through the enemata not being retained, a very small quantity of liquid food may be allowed *iced*, such as peptonized milk, milk-gruel, or beef-peptone in bouillon.

Perforation of the stomach, with resulting peritonitis, in gastric ulcer necessitates the administration of full doses of opium by the mouth or morphine hypodermically. Hot fomentations should be applied to the abdomen; absolute rest in recumbency, with decubitus such as to have the ulcer uppermost, should be enjoined. Feeding

[1] See Wm. Hunter's most valuable lectures on tranfusion, *Brit. Med. Journ.*, vol. ii., 1889.

[2] As Kroenecker's experiments (editorial in *University Medical Magazine*, abstracted in *Polyclinic*, December, 1888) show that a transfused solution of common salt cannot support the heart unless reinforced by proteids, it is suggested by Ringer that other saline solutions not possessing this disadvantage be substituted for that of simple salt. Ringer considers the best of these to be a solution of tribasic calcium phosphate and potassium chloride—salts representing the necessary ones of blood-serum. These he combines in the proportion of 3 fluidounces of a saturated solution of the former with 85 minims of a 1 per cent. solution of the latter. According to Ringer, this solution will stimulate the heart as well as increase the volume of the blood-stream, and might be substituted with decided advantage for simple salt solution when the introduction of a large amount of fluid is attended with the risk above mentioned.

[3] Galabin (*Transactions Obstetrical Soc.*, London, 1890, p. 5) suggests this method after post-partum hæmorrhage. The common-salt solution—from 1 to 3 pints—is introduced by the aid of a sterilized aspirator needle, a piece of gum tubing, and a large funnel. It is diffused, if necessary, by massage. The flow can be accelerated by running the oiled finger and thumb down the outside of the tube.

by the stomach must of course be discontinued. If the stomach is suspected to contain much food, an effort should be made to evacuate the contents by the tube, a full dose of morphine hypodermically preceding its introduction, and cocaine being used locally to obviate nausea and retching, the last of which will tend to increase the size of the perforation.

Perforation of the stomach, with escape of its contents into the peritoneal cavity, is in the vast majority of cases followed by collapse and death in the course of a few hours or days. Surgical interference is warrantable if it is thought the site of the perforation can be reached by laparotomy. To render the operation successful in these cases a more accurate mode of diagnosing the position of ulcers seems essential.[1]

If chloro-anæmia is decided in ulcer, preparations of iron and arsenic should be resorted to for its removal at as early a period as is compatible with their safe admistration. Prior to this much can be done by the observance of rest in recumbency, thus permitting as slight demand on the vital energies as possible. If the stomach will tolerate it equally well, some form of beef food, such as Mosquera's peptone jelly or that of Leube, should be preferred to a diet of milk. A preparation termed *hæmoglobin compound*, made from the formula of Dr. F. E. Stewart, consisting of fresh defibrinated bullock's blood, extract of malt, glycerin, and alcohol, is of very great value as a nutrient and as a synergist to other foods. It may be administered by the rectum as an addition to the ordinary nutrient enema, or, since it is usually well borne by the stomach and is of very agreeable taste, it may also be given by the mouth. The initial dose is 15 drops well diluted, which, agreeing well, may be increased gradually to upward of a dessert-spoonful three to four times daily. Some little experience with this preparation in anæmic conditions enables the writer to speak with confidence as to its value as a reconstructive.

Enemata of defibrinated blood, of which mention has already been made, are also of especial value in combating the anæmia of gastric ulcer. These, when an anæmic condition is marked, are to be preferred to milk enemata. They are borne equally well by the bowel,

[1] See a case reported by Nissere (*St. Petersburger med. Woch.*, No. 41, 1890, abstracted in *Brit. Med. Journ.*, Jan. 3, 1891) in which perforation and commencing peritonitis consequent on ulcer of the stomach was diagnosed. The abdomen was opened. There was no free gas in the peritoneal sac nor other signs of perforation. The stomach readily presented in the wound, but showed no other abnormality than excessive vascularity of the serous coat. The abdomen was closed without further disturbance of its contents. The patient did well until a month after the operation; abdominal pain and collapse then occurred, followed by death. A necropsy showed a perforation in the anterior stomach-wall, due to a large ulcer at the lesser curvature which had extended to the anterior wall and then ruptured. This had been hidden by adhesions binding the left lobe of the liver and stomach together.

and are absorbed as readily. The preparation of iron which agrees best is the albuminate: this may be prepared extemporaneously by combining egg-albumin with iron chloride,[1] or the solution of iron albuminate made by Drees of Bentheim, Germany, may be prescribed instead. The dose of the last is ½ to 1 tea-spoonful three times daily. It seems to be better borne than other salts of iron, and may be given by the mouth even in the active stage of ulcer and in cases in which hæmatemesis has recently occurred.[2] Small doses of Blaud's pill also agree very well, provided the pill is soft and that decomposition of the iron sulphate and potassium carbonate have not occurred in its construction. The initial dose should be 1 to 2 grains three times daily, gradually increased to a much larger quantity if the stomach remains tolerant. Reduced iron is also usually well borne, and may be prescribed with althæa powder and gelatin made into soft pills, as recommended by Leube.[3] The salts of iron with the vegetable acids, such as the citrate and lactate, are usually easily digested, though of less efficiency than those before mentioned.

It is rarely necessary to resort to the hypodermic method of administering iron: should it be employed in this manner, the least irritating salt is perhaps the citrate, used in aqueous solution in doses of 1 to 4 grains. Arsenic may be given in pill form in combination with iron or preferably alone in solution—the official Fowler's solution or liquor acidi arseniosi; the latter of which seems to be more certain in its effects than the former. Either may be used in doses of 1 drop, increased to several if well borne, three times daily after meals.

Pyloric stenosis not rarely succeeds cicatrization of gastric ulcer and leads to obstructive dilatation, necessitating surgical interference for its alleviation. The question of operation is briefly considered in the therapy of Dilatation of the Stomach.

CANCER OF THE STOMACH.

Cancer of the stomach is not only an incurable malady, but one the progressiveness of which is little subject to retardation by medical

[1] Ewald (*op. cit.*, p. 237) prescribes a tea-spoonful of 2 or 3 per cent. solution of ferric chloride to a wine-glassful of a solution of egg-albumin (1 part of white of egg to 2 of water), to be taken through a tube several times daily. This he regards as efficient as the proprietary preparations of iron albuminate, and much less expensive. Tincture of iron chloride alone, well diluted, often agrees very well, and in doses of 3 to 4 drops is recommended by Gerhardt for the relief of the pain of gastric ulcer.

[2] Griffith, *Medical and Surgical Reporter*, May 16, 1891.

[3] Leube's formula is reduced iron and althæa powder, of each 1 grain, and sufficient gelatin to make a soft pill.

means. A consideration of its therapy, therefore, limited as the latter is to mere symptomatology, is less inviting than that of the affections previously discussed. It is, however, of consequence, since, if the downward progress of the disease cannot be decidedly controlled, the accompanying symptoms, which tend to render the patient's last days miserable, may be so far controlled as to permit comparative comfort during this period.

The diet is of the first importance. By its judicious regulation the severity of several of the more distressing manifestations of the disease, such as vomiting and pain, may be diminished, nutrition maintained, and the comfort of the patient promoted until the advent of a fatal termination. Because of the almost invariable absence of free hydrochloric acid from the gastric secretion in advanced cases of cancer of the stomach, and of the tendency of the growth, from its usual situation, to encroach upon and constrict the pylorus, the diet should consist, except in the early period of the disease, when both secretion and motility for a time may be unaffected, only of such aliment as will either readily enter the circulation from the stomach or pass the narrowed pylorus and undergo absorption in the bowel. The diminution in, or more frequently the entire absence of, free hydrochloric acid in the gastric secretion, and the presence of lowered motility, necessitate the administration of predigested aliment, of which, when the latter is used, animal is preferable to vegetable, as it is less liable when absorption is tardy to undergo fermentation, with the production of the organic acids and other irritating products, the presence of which in the stomach will aggravate the patient's discomfort and increase the liability to development of secretory disturbances; and as there is apt to be a loathing for animal food, largely due to the inability to digest it, an albuminoid dietary can be best taken in a semifluid or fluid condition.

Because of the incurable nature of the malady, however, the inclination of the patient as far as possible should be consulted, the sole object in restricting the dietary being to maintain nutrition and diminish the severity of such of the symptoms as are likely to be aggravated by injudicious feeding. Soft aliment should not be resorted to if solid food can be taken, as the patient soon wearies of it, however palatably it may be prepared. Its constant use, unfortunately, is demanded early in the case, when complete anorexia and pyloric obstruction develop.

In those exceptional cases in which hydrochloric acid is present in excess or in normal amount, or in which its secretion is not decidedly diminished,[1] and the preservation of a fair peristole still permits effi-

[1] There seems little doubt that the absence of hydrochloric acid in cancer of the stomach is due to disturbance of the secretory structure, leading to atrophy of the tubules, most likely produced through the concomitant gastritis. In those rare cases in which secretion of hydrochloric acid has persisted until death, despite the presence

cient gastric digestion and transference of the chyme into the bowel, considerable license may be permitted, ordinary care being exercised that no food is indulged in that causes marked discomfort or that will aggravate the tendency to gastritis, which becomes decided with the progress of the cancer.

When symptoms of pyloric constriction and those of impairment of digestion are absent, whether due to the growth occupying the body of the stomach or when adjacent to the pylorus, though of too small size to obstruct the orifice or interfere with peristole, retention of food in the stomach not being favored, both a farinaceous and an animal dietary may be allowed.

If hydrochloric acid is simply diminished, its presence in a free state still being shown by Günzberg's or the calcium-carbonate test, and symptoms of obstruction are absent or only slightly marked, the administration of hydrochloric acid in the manner and doses suggested in the treatment of Chronic Gastric Catarrh is indicated. Pepsin may also be necessary, though its secretion in carcinoma of the stomach is rarely, if ever, diminished in the same degree that hydrochloric acid is, the former and the milk-curdling ferment being usually present to the end,[1] unlike what occurs in primary gastric atrophy or that secondary to gastric catarrh, in which pepsin, acid, and lab-ferment are all absent. The persistence of hydrochloric acid in small quantity in the combined state only is not an indication for the employment of this acid, but rather for the previous peptonization of all albuminoids ingested, or a resort to an easily-digested farinaceous aliment or to the administration of pancreated preparations with the latter.

A concentrated fluid diet, representing considerable nutriment in small bulk, is especially indicated during the middle and later periods of the disease, when the digestive functions are much disturbed and narrowing of the pylorus has occurred. Some form of peptonized beef should then be used, such as was mentioned in discussing the therapy of chronic gastric catarrh and of ulcer. Yelk of egg may be combined with the most soluble of these, or they may be exhibited with yelk of egg in bouillon. Peptonized milk or peptonized milk-gruel may be used to vary the dietary, as may also such preparations of predigested

of cancer, the mucous membrane, except in the immediate locality of the cancer, has been found in a normal condition post-mortem; and, on the contrary, in those cases in which hydrochloric acid has been persistently absent from the gastric secretion, marked atrophy of the mucous membrane has been found. See Rosenheim's cases (*Berliner klin. Woch.*, Dec. 24, 1888), in which atrophy of the mucous membrane was found in 12 in which hydrochloric acid had been absent from the gastric secretion. In 2 others hydrochloric acid had been secreted in excess. In these the mucous membrane was not atrophied. See also Ewald's case (*Berl. klin. Woch.*, Dec. 3, 1888), in which hydrochloric acid had been diminished and no atrophy was found post-mortem.

[1] V. Jaksch, *Clinical Diagnosis*, London, 1890, p. 110.

beef and cacao, which, taken with milk, are palatable and usually well borne. The amount of nourishment taken at one time should be limited, frequent small meals being preferred to large ones at longer intervals.

Carbonated drinks should be avoided, save in the smallest quantities. Champagne, however, is often well borne, and is an efficient analeptic in doses of a tea-spoonful to a table-spoonful. If stimulants are constantly indicated, a strong not over-sweet red wine agrees best.

When the cancer involves the cardia, producing stenosis of that orifice, usually shown by regurgitation of food immediately after it is swallowed, the presence of persistent dysphagia, of pain situated behind or near the xiphoid appendix, of retraction of the epigastrium, and of an obstruction encountered in the attempted passage of a stomach-tube or œsophageal bougie, fluid food can alone be taken, and the ingestion of this is often impossible without resort to a stiff stomach-tube. The only other resource besides the formation of a gastric fistule is feeding by the rectum. But as life cannot be long sustained by the last, apart from the many disagreeable features attending it, the question of gastrostomy should receive serious consideration. The risk attending the operation is not great, and the comfort of the patient in being nourished in that way instead of by the rectum is very decided. Lavage may be accomplished through the fistula, and medicine as well as food introduced in that way. Ewald recommends in cases in which gastrostomy is performed, and in which, through absence of hydrochloric acid, gastric digestion is impossible, that the fistule be made as near the pylorus as possible, so that the feeding canula may be introduced through the pylorus into the duodenum.

For the relief of pain of gastric cancer opium in some form, such as the deodorized tincture, or, preferably, morphine, is indicated: either may be given in solution with 2 to 4 drops of dilute hydrocyanic acid, and a few grains of bismuth added if vomiting is also present, or in pill, combined with extract of belladonna and cannabis indica. Severe paroxysmal pain, not promptly controlled by the stomach administration of opium, necessitates the use of morphia hypodermically, preferably associated with atropine.

The occurrence of vomiting calls for careful regulation of the diet and a resort to predigested food. When it continues despite a diet restricted to small amounts of iced peptonized milk or milk-gruel, rectal feeding must temporarily replace that by the mouth. The drugs most suitable for its control are those suggested for vomiting accompanying ulcer, such as pellets of ice, tea-spoonful doses of iced carbonated waters or champagne; counter-irritation or an iced bag to the epigastrium sometimes is of service. Occasionally remedies which apparently are least indicated succeed. Thus in a case of Ewald's

weiss beer, which had been craved, was efficient. When vomiting is due to stenotic dilatation of the stomach, occurring at the usual intervals of several days, the ejecta being profuse in amount and much decomposed, it can only be controlled by lavage and a restricted predigested fluid diet, much as in the treatment of gastric dilatation. The hæmatemesis of cancer is to be treated as is that of ulcer.

Gastric catarrh, which occurs with sufficient frequency in cancer to be regarded as a part of that disease, requires an identical therapy to that already detailed in the treatment of gastritis. Of the stomachics for this condition, condurango seems especially worthy of mention. So much benefit, indeed, has resulted from its use in chronic gastritis, in which cancer was also suspected, that it was at one time regarded in the light of a true specific for the latter. Through its influence on the gastric catarrh of cancer vomiting and pain are often lessened, and appetite, in the earlier stages at least, promoted. The best mode of employing it is in macerated decoction, after the formula of Friedreich, the report of whose cases of supposed cancer of the stomach ameliorated by condurango led to its extensive trial in this affection with the mistaken idea that it would prove a specific. Half an ounce of condurango-bark is macerated for twelve hours in 13 fluidounces of water, which is evaporated by boiling to one-half this quantity, strained, and a table-spoonful is taken three times daily. Ewald recommends the addition of a carminative syrup to the decoction to render it more palatable, such as ginger, mint, or fennel, and from 0.3 to 0.5 per cent. of hydrochloric acid to increase its stomachic effect. The last, however, would probably be useless, save as an antifermentative, when free hydrochloric acid is absent from the gastric secretion.

Fermentation occurring in the stomach in cancer, and causing pyrosis and acid eructations, demands a therapy similar to that recommended for the same condition in gastric catarrh and gastrectasis. Daily washing out of the stomach with simple water or dilute solution of the antifermentatives, such as sodium sulphite, boric acid, hydronaphthol, or of bismuth salicylate, is much the best remedy. Lavage also controls the vomiting due to retention and subsequent fermentation of the ingesta, occurring when dilatation arises from constriction of the pylorus. It is, indeed, the most efficient remedy for the relief of all the symptoms accompanying stenotic dilatation, and should be regularly used unless great prostration and a tendency to hæmatemesis are present.

Resort to antacids is more frequently necessary than with chronic gastric catarrh, since we cannot hope more than temporarily to influence the condition originating fermentation in cancer, unlike what is the case in gastric catarrh.

Pyrosis is often very decided, due to the development of large quan-

tities of the fatty acids. Alkalies joined with antifermentatives are then especially indicated. The combinations suggested by Beaumetz[1] are very serviceable, such as a powder containing 5 grains each of sodium bicarbonate, salol, and bismuth salicylate, or of bismuth salicylate, naphthol, and powdered charcoal, or of bismuth salicylate, magnesia, and sodium bicarbonate.

Because of the absence of hydrochloric acid from the gastric secretion in most cases of cancer, the administration of this acid can be of but little avail, either temporarily or permanently, in pyrosis originated by the presence of the organic acids, as a larger amount would be required to prevent the occurrence of fermentation than could at one time be well borne by the stomach.

The obstinate constipation of cancer is sometimes relieved by lavage. Vegetable aperients, aloes, cascara, rhubarb, and the like (mentioned under Chronic Gastric Catarrh), are very serviceable. Saline purgatives should be used with caution; they are apt to debilitate and may lead to diarrhœa. Warm-water enemata are an efficient mode of relieving impaction due to atony of the colon.

Diarrhœa, which occasionally alternates with constipation, and is common toward the termination of the disease, due to irritation of indigestible food or to catarrhal enteritis, can be controlled by opium administered by the mouth or rectum.

Anæmia accompanying gastric cancer, due both to the influence of the cancer on the process of nutrition and to the impaired gastric functions, is sometimes so decided as to approach the condition termed *pernicious*. Indeed, it has occasionally happened that cases of gastric cancer have been mistaken for pernicious anæmia, the symptoms of the former malady not being sufficiently marked to attract notice. The red blood-cells may be reduced to less than a million per cubic millimetre, and assume the distorted shapes and varied sizes characteristic of pernicious anæmia. In other cases, and more commonly, the anæmia may be of moderate grade and show no tendency to develop into the pernicious variety. In all arsenic is of most value to stimulate hæmogenesis, and iron may also be used if coincident diminution in hæmoglobin is present. All treatment can be but palliative, the cause persisting.

The question of operative interference in cancer of the stomach, with the object of extirpating the growth, is one of the highest importance, in view of the utter inability of the physician to accomplish more than alleviation of the chief symptoms, and thus stay the downward progress of the disease for only a short period. This cannot, however, be noticed here in more than the barest outlines.

The mortality attending resections of the pylorus for cancer depends largely upon the amount of adherence to surrounding parts,

[1] *Journal de Médecine et de Chirurgie Pratiques*, 1890, p. 519.

the degrees of cachexia, and the skill of the operator. Too few pylorectomies have been attempted sufficiently early in the disease for a very definite idea to be formed of the immediate risk of operation at that time. The absolute certainty of an ultimate fatal termination of the disease without operation, and the very fair chance of non-return, at least for some time, if pylorectomy could be performed while the disease is yet local and before adhesions have formed and cachexia exists, should cause the operation to be recommended. The risk cannot be so great as that of operation for cicatricial stenosis after dilatation of the stomach, with its accompanying dyscrasia, whether the stenosis be of cancerous or non-cancerous origin. And even in cancerous stenosis the results have been sufficiently encouraging to justify operation in a more advanced stage if the growth is but slightly adherent and debility not too decided.

If the existence of cancer is strongly suspected very early in its course, an exploratory operation, the danger from which in these days of surgical asepsis is trifling,[1] should be resorted to with a view to a confirmation of the diagnosis and extirpation of the growth should it appear that metastasis has not occurred; and, unfortunately, apart from the question of risk attending the operation of resection in cancer of the stomach, cases are usually encountered too late for benefit to be more than palliative, even when the affection is recognized in its earliest stages, as rarely occurs; for, though the tumor may be recent and small, and without definite symptoms, metastasis may already have occurred.[2] When metastases in surrounding parts exist, their complete removal is rarely possible, and a return of the growth in the near future is certain. If the tumor is not very adherent and metastasis is thought to be slight, the strength of the patient permitting, resection of the growth, especially when completely constricting the pylorus, may be indicated, even though its return seems probable, for if the patient survives the operation a period of comparative comfort is assured. If distant metastases have occurred, or the adhesions binding the growth to other parts are too great to justify a pylorectomy, and the patient's physical condition permits, the feasibility of gastro-enterostomy should be considered—indeed, from the risk being decidedly less and the immediate and ultimate[3] result about similar to

[1] Czerny (*Deutsche med. Woch.*, Nov. 7, 1890, quoted by Mears, *Annual of the Universal Medical Sciences*, 1891) reports 14 exploratory incisions, 13 of which were for cancer. Of the 14, 1 terminated fatally on his attempting to isolate a tumor.

[2] In Birch-Hirschfeld's case, quoted by Welsh (Pepper's *System of Medicine*, vol. ii. p. 575), numerous metastases existed in the lymphatic glands of the omentum and of the lesser curvature, though the tumor—a non-ulcerated cancerous one—was not larger than a silver half-dollar and had given rise to no symptoms.

[3] Since the introduction of Senn's bone-plates and Abbé's catgut rings, by which the technique of gastro-enterostomy has been wonderfully improved, the mortality from

that of resection of cancer with existing metastasis, gastro-enterostomy should be preferred in all cases with pronounced pyloric stenosis, in which the probability of a return of the growth after a pylorectomy seems probable.

DILATATION OF THE STOMACH.

THE curability of gastrectasia depends largely upon whether dilatation is the result of atony of the gastric musculature or is secondary to another affection which usually originates dilatation by the production of obstruction of the pylorus.[1] As pyloric stenosis is the most frequent cause of pronounced dilatation, the form for which relief is most often sought, it may be said that an actual cure of dilatation is rarely obtained. This is especially true when the obstruction arises from cancer, which of itself is incurable. It is less true of ulcer or the more rare causes of stenotic dilatation, the obstructions produced by which are more susceptible of permanent removal by surgical means.

The non-malignant stenotic forms, the actual curability of which depends upon the removal of the obstruction, impossible without surgical interference, can by medical means be vastly helped and life prolonged, though they cannot of course be actually cured. Dilatation, however produced, is at least susceptible of decided amelioration, but that form arising in consequence of disturbed digestive functions occasioned by chronic gastric catarrh[2] or by simple atony, originated secondarily by conditions which depress nutrition and cause disturbance of motility, secretion, or absorption, such as tuberculosis, anæmia, or fevers, such as typhoid, or in consequence of habitual excesses in eating or drinking, offers the best chance of permanent cure.

The prophylaxis of gastrectasia is in the main similar to that of gastric catarrh, which, having already received consideration, need not be again discussed here.

this operation has been much lessened. Prior to the use of Senn's plates or some of their modifications the mortality in 24 cases of carcinomatous stenosis was 42 per cent. In 11 cases in which these were resorted to the mortality was but a little over 9 per cent. (See a lecture by Weir, *Medical News*, Dec. 14, 1889.)

[1] As pointed out by Welsh (Pepper's *System of Medicine*, vol. ii. p. 590), cancer and ulcer, though situated near the pylorus, may cause dilatation, not by obstructing the outlet of the stomach, but indirectly by causing partial destruction of the muscular coat, interfering with normal peristalsis.

[2] It might be stated that gastrectasia occurring in the course of chronic gastritis may be due to another cause than primary atony of the musculature or disturbance in secretion and absorption—to an obstructed pylorus produced by diffused thickening of the mucous membrane in this locality, a not uncommon sequence of advanced gastritis.

In the treatment of this affection attention to diet is of the first importance. Without it neither a cure nor decided amelioration in the symptoms can be expected. The food must be of such a concentrated, easily-digestible character that, while meeting the requirements of nutrition, it will tax the various functions of the stomach, especially the motor, as slightly as possible.

Because of the prolonged stay of the ingesta in the dilated organ the aliment should be not only easy of digestion, but, if not already predigested, capable of ready transformation in the stomach into products most easily absorbed from that viscus. For this reason carbohydrates and fats, which are digested chiefly in the bowel, and which have a tendency to undergo decomposition in the stomach, should be permitted only in the smallest amount, and liquid aliment, furnishing small nutriment in great bulk, as thin soups and milk, or beverages, such as water, tea, coffee, and light alcoholic drinks, must also be partaken of as sparingly as possible. Absorption of fluids is always delayed in gastrectasia. These, stagnating in the stomach, distend that viscus by their weight, favor fermentation, and augment the tendency to dilatation.

The most satisfactory diet would be a predigested one, such as is furnished by preparations of peptone, which demand little or no effort on the part of the stomach for their digestion. Food of this sort is, however, soon wearied of, and is indeed habitually indicated only in advanced cases of dilatation, when the secretory function is almost entirely in abeyance. Usually a resort to peptones is necessary only for short periods, and more often in cases of obstructive than in simple atonic gastrectasia. What would appear to be the most satisfactory form of these foods was mentioned in the therapy of Chronic Gastritis and Ulcer. The use of peptonized condensed milk may also be mentioned. This has high nutritive power, a pleasant taste, and, according to Ewald,[1] is not readily wearied of.

From what has been said, it will be seen that the best dietary is an animal one, and in that form most easy of digestion—tender meat, beef, mutton, or fowl, free from fat and fibrous structure, eggs, soft boiled, and the white flesh of fish—essentially, indeed, the diet of chronic gastritis, though in a more concentrated form, with still more sparing use of farinaceous substances. A very limited amount of the latter, however, may be allowed. They are craved by the patient, who cannot be expected to continue long without variation on a restricted predigested dietary. The best farinaceous aliments are those containing the least amount of starch or sugar. Macaroni, stale white bread, and some of the fresh green vegetables, such as young peas, asparagus, and tomatoes, all in small amounts, may be per-

[1] Ewald, *Die Krankheiten des Magens*, 1888, p. 128.

mitted, provided symptoms of indigestion are not induced or aggravated by their use. Fruit may often be allowed when it seems to agree, though in the greatest moderation: grapes (the seeds being carefully rejected), the juice of oranges, the best quality of pears and apples (preferably stewed), are those least apt to occasion gastric disturbance. All thirst-creating foods must be avoided, so that craving for fluids be not engendered when dilatation is decided. Then, also, the quantity of liquid taken at one time should not exceed 6 fluidounces, and ought to be less. As liquids are more readily absorbed in the empty stomach when ingested warm, they should by election be so taken, especially water. A small amount of hot water before a meal will not only assuage thirst, checking the desire for drink with the meal, but will also tend to prepare the stomach for the reception of the latter when symptoms of mucous gastritis are prominent. If the moderate use of milk seems not undesirable because of little other nourishment being taken, a small tea-cupful, alkalinized, may be permitted several times daily, depending upon how it agrees.

In cases of moderate dilatation a little unsweetened coffee or tea may be allowed; wine of good body or a small amount of dilute spirits, if weakness is decided and dilatation is not dependent upon gastric catarrh, may be taken.

It has been suggested, as gastric absorption of fluids is delayed, and as their ingestion is likely to aggravate dilatation and catarrh when much thirst is felt, that this be largely met by water enemata. This is, however, ordinarily necessary only in the grave form of gastrectasia, in which dilatation is decided and gastric absorption much delayed. In the same class of cases, when adequate nourishment is not offered by regulated mouth-feeding, aliment must also be administered by the rectum, or it may be necessary to substitute for short periods rectal feeding for that by the mouth.[1]

To assist the digestion of non-peptonized aliment if secretion of hydrochloric acid is diminished, as it is apt to be from the first, in atonic dilatation, especially when dependent upon a chronic gastritis, and later also in dilatation succeeding pyloric stenosis, even though the latter is originated by ulcer,[2] hydrochloric acid, and perhaps also pep-

[1] The methods of using nutrient enemata and their character are described under Gastric Ulcer.

[2] In dilatation depending upon cicatricial stenosis due to simple ulcer, and in atonic dilatation with absence of catarrhal symptoms, not only the presence of hydrochloric acid in the gastric secretion should be ascertained, but a rough quantitative estimate ought also to be made. It sometimes happens that in consequence of the prolonged stay of the ingesta in the stomach in dilatation without a coexisting gastritis, an excessive production of hydrochloric acid results. See Leo, *Diagnostik der Krankheiten der Verdauüngsorgane*, Berlin, 1890, and also Klemperer, *Verhandlungen der Congres für Innere Med.*, Wiesbaden, 1889. The latter found in 17 cases of gastric dilatation without pyloric obstruction hydrochloric acid in excess in 8, normal in 2, and diminished

sin, are indicated, as in the treatment of chronic gastritis itself, which in dilatation not frequently underlies secretory failure. If carbohydrates are also permitted, the digestion will be facilitated by a pancreated preparation administered immediately before or during the meal.

Excepting strychnine, drugs are of little utility in dilatation, save to meet symptomatic conditions. Strychnine justly ranks high as a stimulator of motility through its power to restore tone to relapsed and debilitated muscle-fibre. It is of especial service in gastrectasia not dependent upon obstruction. Through its power as a secretory stimulant also it aids the production of hydrochloric acid.[1] It should be used preferably in the form of the sulphate in doses of from $\frac{1}{60}$ to $\frac{1}{16}$ grain three or four times daily.

The intragastric application of electricity, especially faradism, is of greater utility even than strychnine. It is unquestionably the most efficient agent we possess to reduce the capacity of a dilated stomach and impart tone to its walls. Its beneficial influence in this direction has long been suspected, but its intragastric application has been resorted to only in late years. Canstatt[2] first suggested its use, and Duchenne[3] and Kussmaul[4] soon after tested the method. Since then it has received somewhat general though not very extensive trial, because of the annoyance attending its application due to the lack of a convenient form of gastric electrode. This has been recently largely obviated by the excellent device of Bardet,[5] and the still more useful contrivance of Einhorn. In view of the ease of application of these electrodes or of one of the modifications of Bardet's, and in view also of the beneficial results which, it would appear, may be obtained in cases of lessened secretory activity and in muscular atony with or without marked dilatation, it seems curious that the intragastric application of electricity is not more often resorted to. In dilatation dependent upon constriction of the gastric outlet little can be expected other than temporary strengthening of the musculature, and the maintenance of the latter in a fair state of nutrition; but in atonic dilatation the persistent use of intraventricular electricity should be permanently curative, especially with the combined employment of other

in 7. It is of course important not to give hydrochloric acid in these cases, the character of which can usually only be recognized by the use of the stomach-tube.

[1] Ewald (*op. cit.*, p. 136) states that experiments in his laboratory show that strychnine may be classed as a secretory stimulant.

[2] Quoted by Kussmaul, *Arch. f. Psych. u. Nerv.*, 1887, viii.

[3] The method of using Einhorn's electrode is elsewhere described; Bardet's and other electrodes in the form of a stomach-tube are introduced in a similar manner to the stomach-tube.

[4] Kussmaul, *loc. cit.*

[5] Bardet, *Bull. gén. de Thérap.*, 1884, t. 106, p. 529.

efficient measures, such as lavage. Daily applications, of from ten to fifteen minutes' duration, should be made for a length of time depending upon the promptness with which the dilatation is overcome and its reduction maintained. It should be tried daily for a period of from two to four weeks, and subsequently on alternate days for a much longer time. Its application is so simple that the patient learns to manipulate it himself even more readily than the stomach-tube for irrigation purposes.

The electrical session may be at the time of the morning lavage, a half hour or more before breakfast, or at the same interval preceding the evening meal, or on retiring. The current should be sufficiently strong to produce distinct contractions of the stomach. That viscus must contain a half pint or more of warm water; what remains of this in cases of dilatation had better be afterward withdrawn by the tube. For this reason, if it is thought that the stomach is comparatively free from ingesta, it may be irrigated immediately subsequent to rather than before the electrical application, as then it will be necessary to introduce the tube but once. This will usually be the case after lavage and electricity have been used a few times.

Strong percutaneous faradic applications are also of great utility in gastrectasia, though much less useful than when the electrode is introduced within the stomach. The effects of external faradic applications are not unlike those of massage, inducing indirect gastric peristalsis through the production of contraction of the superjacent muscles, hastening somewhat the onward passage of ingesta from the stomach, thus lessening stagnation in that viscus.[1] It is not improbable that reflex gastric peristalsis can also be produced in this way, the sensory skin-nerves affording the afferent path. The current should be of sufficient strength to produce energetic contraction of the abdominal muscles. Ziemssen[2] recommends for the percutaneous application a large flat electrode. One (600 sq. cm.) is placed on the pyloric region, extending from this toward the fundus, at a distance of not over 1 to 2 cm. from the smaller (500 cm.), which lies between the fundus and the spine. A massage (or roll) electrode may be advantageously substituted for one of the above. By its employment massage, which is often distinctly useful in gastrectasia, promoting the passage of the stomach-contents through the pylorus and aiding secretion, becomes less important than if flat electrodes are alone used for percutaneous applications.

[1] Ewald and Sievers (*Therap. Monatsh.*, Aug., 1887; and *Die Krankheiten des Magens*, ii. 1888, p. 133) found that the salol reaction in the urine could be hastened from fifteen minutes to half an hour by energetic percutaneous faradization of the stomach both in the normal condition and in gastrectasis.

[2] *Allgemeine Diagnostik u. Therap. der Magenkrankheiten*, Leipzig, 1890, p. 239.

The employment of electro-massage or massage alone is most provocative of benefit when used systematically two to five hours after a meal, and for periods of ten to fifteen minutes. The massage movements, both stroking and kneading, should be from the fundus and cardia toward the pylorus, gentle and superficial at first, and after a few minutes' manipulation more energetic. The patient should be supine, with abdomen relaxed. At the termination of each treatment the massage should be extended to the abdominal muscles.[1] Douching of the epigastrium with a small or large stream of cold water or with water at a constantly varying temperature, succeeded by friction with a coarse towel, is also useful, and will often aid strychnine, electricity, and massage in imparting tone to the dilated organ even in intractable cases.

When pronounced bulging of the epigastrium exists, a cushion pad, confined by a bandage, constantly worn, sometimes tends to relieve the sensation of fulness and weight present in gastrectasia.

To relieve ectasic symptoms promptly, to prevent stagnation and fermentation of the ingesta, and to stimulate the stomach and bowels to the better performance of their functions, no one remedy so well meets all the indications, and is so productive of benefit, as washing out the stomach. This should be resorted to at an early as well as a late period of the disease, as soon as the case comes under observation. It should be systematically continued so long as evidence exists of retention of food in the stomach much beyond the normal period of gastric digestion. The unpleasant effects of dilatation, retention and fermentation of the ingesta, periodical copious vomiting, and other symptoms indicative of disordered digestion occurring in consequence of simple dilatation or of an accompanying gastritis, are not only relieved, but in dilatation due to simple atony of the musculature not dependent upon stenosis of the pylorus, and in which decided degeneration of the stomach-wall has not occurred, a cure may be often confidently looked for under systematic daily lavage, even without resort to the other measures suggested, the use of which are, however, also commonly demanded in pronounced cases of gastrectasia in order that results of any permanency be obtained.

Under lavage not only are the symptoms occasioned by stagnation of food ameliorated or removed, and more or less tone restored to the relaxed and overstretched muscles, but the gastric absorbent and secretory functions, often profoundly affected in dilatation, are stimulated

[1] See Cseri's "Mechanical Treatment of Chronic Dyspepsia," *Wiener med. Woch.*, abstracted in *Lancet*, Sept. 20, 1890; also Labludowski ("Zur Massagetherapie," *Berl. klin. Woch.*, p. 443, 1886, quoted by Ewald, *Die Krankheiten des Magens*, Berlin, 1888, p. 132), who narrates interesting results obtained in gastrectasia from massage, and also gives the exact technique of the application.

to renewed activity. In consequence of the beneficial effects, even in cases of incurable stenotic dilatation, which prior to the commencement of lavage have been emaciated and cachectic in appearance to a high degree, an extraordinary change for the better may appear in the course of a few weeks or months, though the amount of food taken has been but slightly in excess of that formerly ingested.

The most suitable time for the performance of lavage is in the morning, half an hour to an hour before breakfast, or at the end of the seventh hour after a meal, when normally the stomach should be empty, and when, if it is not, ingesta remaining, whether partly chymified or wholly undigested, are stagnating and undergoing fermentation in cases of gastrectasis.

Lavage should be systematically done at least once daily, and so continued for weeks until not only maintained improvement in subjective symptoms but decided objective results are noticeable, such as diminution in or absence of dyspeptic symptoms, constipation, emaciation, and in primary atonic dilatation reduction in the size of the enlarged organ. Then, when but slight danger of relapse exists because of prolonged continued improvement, irrigation may be employed on alternate days only, but should be persisted in at least bi-weekly until the long-continued absence of symptoms of dilatation indicates that a cure has resulted, or, if the latter is impossible, for the remainder of life.

Lavage is so simple of accomplishment, and so free from all risk[1] when the siphonage method with the soft tube is used, and relief is so decided that patients soon grow accustomed to the manipulation of the tube. It may be entrusted to them after they have been duly instructed in its use.

The apparatus that fulfils all the requirements for lavage consists of a fair-sized, well-fenestrated soft-rubber tube, either of black or red gum, and a hard-rubber funnel. This should be preferred to more

[1] One untoward result—tetanic spasm or epileptiform convulsions—occurs rarely subsequent to lavage in advanced cases of dilatation when pronounced emaciation and debility exists. These spasms were first noted by Kussmaul, and considered by him to be analogous to those taking place in cholera asphyxia, and due to a similar cause—diminution in the fluids of the body with abnormal dryness of the tissues. Tetanic spasms, the more usual of these rare nerve-disturbances, are more frequent succeeding profuse vomiting or the use of the tube to empty the distended stomach than after mere lavage, though one death has been reported (Martin, *Lancet*, vol. i., 1887, p. 74) from them, following washing out a dilated stomach. As these spasms are more likely to occur when dilatation is pronounced, gastric absorption diminished, and periodical vomiting frequent, it would appear, theoretically at least, that the use of lavage should rather prevent than determine their occurrence; and, as they happen much more frequently after profuse vomiting than subsequent to lavage, this is probably the case. The free use of warm-water enemata when gastric absorption is delayed, fluid being supplied to the tissues in this manner, should prevent them, and the early employment of large doses of nitro-glycerin or amyl nitrite hypodermically, or the latter by inhalation, would in all likelihood promptly jugulate them.

complicated and expensive apparatus,[1] or to the hard-rubber stomach-tube used with the pump, the employment of which possesses no distinct advantage over siphonage with the soft tube, and even in the hands of the physician is not unattended with danger.

The soft, red rubber tube, the consistence of which is somewhat firmer than that of the pure (black) gum tube,[2] is a trifle more convenient to introduce, as its ingestion can be accomplished without efforts of swallowing, and for that reason is preferable to the tube of pure gum. Either of these forms of tube may be employed. It must be of sufficient length for the intragastric extremity to reach the most dependent part of the stomach, and the external portion to extend several feet below the stomach level, to permit of ready siphonage.

The wash-water should be introduced warmed. The quantity used must be accurately noted, that all is withdrawn before removal of the tube. The water should be poured gently into the funnel. The latter must be held slightly above the head of the patient, who may be either seated or standing. After a pint or more of water has continuously passed through the funnel, and while the latter still contains sufficient to prevent the ingress of air with the fluid, the tube is tightly pinched between the fingers and the funnel is lowered to several feet below the stomach level, and the contents siphoned off by slightly inclining the former, so that an outflow will occur without a coincident entrance of air into the tube, which would check the action of the siphon. Water should then be repeatedly introduced and removed until it returns clear and free from suspended particles of mucus and food. If decided gastric catarrh exists, alkalies may be added to the wash-water, as directed under the treatment of Gastritis. When fermentative processes are active, a pint or so of the last wash-water introduced should contain small quantities of a mild antiseptic, such as sodium borate, sulphite, or salicylate; boric acid, the solubility of which is increased by sodium borate, may be used; or, if preferred, naphthalin, resorcin, benzoic acid, potassium permanganate, or one of the many other antiseptic substances in common use, may be resorted to.

Antifermentatives may also be administered in the usual way, as

[1] When mucus or particles of ingesta have a tendency to block the fenestra of the tube when used as a siphon, and cannot be dislodged by the introduction of more fluid or by the expression method, or by voluntarily straining and forced coughing, the obstruction may be removed either by withdrawing the tube or by the application of gentle suction to its outer extremity through a tube of an enema-syringe, or preferably by means of the simple aspirating apparatus used by the writer for obtaining the undiluted stomach-contents after a test-meal. Sufficient rarefaction of air in the bottle can be produced by this to cause a prompt outflow, especially when the bottle is held below the lower level of the stomach, though thick masses of mucus are present or though the ingesta are not fluidified.

[2] These tubes and the mode of introduction have been already described.

directed in the treatment of Chronic Gastric Catarrh and Gastric Cancer.

A tendency to obstinate constipation is present in gastrectasis. This is usually efficiently overcome by lavage. Indeed, the utility of the latter in this direction is so decided and constant that Kussmaul was led to assert that when it does not result a non-compensatable disorganization of the stomach and an irremediable pyloric obstruction may be suspected to exist. As an adjuvant to lavage saline laxatives may be employed. Carlsbad salt in powder or crystalline form, Hunyadi Janos water, or a readily combined substitute for these can be used, ingested warm while fasting, as described in the therapy of Gastritis. The vegetable purgatives there mentioned may also be employed. In pronounced conditions of atony drastic cathartics are sometimes required, such as colocynth and scammony. They should, however, be avoided when possible, because the depression which their action will result in is very dangerous to the subject debilitated by prolonged inanition.

For the more permanent relief of symptoms of dilatation when ectasia is dependent upon pyloric narrowing several surgical procedures have met with more or less favor in recent years. These are pylorectomy, digital divulsion of the pylorus, pyloroplasty, and gastro-enterostomy. It is not within the province of this work to enter into a discussion of the merits of these. The utility of pyloric excision in cancer has already been outlined. This operation, because of its gravity and the high mortality which must attend it, even with the most approved technique and in the hands of those most skilled in the field of gastric surgery, can rarely be indicated in cases of non-malignant stenosis. For the radical removal of simple constriction the operation devised and popularized by Loreta of Bologna, mechanical divulsion of the pylorus, is attended with less risk, and, apparently, affords equally good results. The fear at first entertained that these results would not be permanent —that, as most frequently occurs with dilatation of cicatricial stricture in other situations, such as the urethra and œsophagus, recontraction would occur—seems to have been unfounded, at least as regards those cases in which divulsion is thoroughly effected.[1] The chief dangers attending the operation are shock and hæmorrhage, the latter occurring from the site of the primary incisions and as a result of laceration of the gastric mucosa during divulsion. Fatal peritonitis also occurred in one of Loreta's cases, due to rupture of the peritoneal investment of the pylorus. Since the permanency of the result depends upon the com-

[1] Loreta stated to Bull (*Medical Record*, June 8, 1889) that but 3 of his cases had relapsed; 2 of these were again operated upon, and permanently recovered. Loreta had then, according to Barton (*Medical News*, May 25, 1889), operated about thirty times.

pleteness of the dilatation, the liability to rupture of one or more of the stomach coats is always considerable, even though the divulsion is accomplished very gradually. The mortality in the 25 published cases tabulated by Barton[1] was 40 per cent. In the last 12 of the 25 reported, however, there were but 3 deaths. A fatal issue in most instances is the result of shock, probably due, as suggested by Barton, to the operation being postponed until too late a period in the disease.

Pyloroplasty, an operation devised by Heinicke[2] for the removal of pyloric stenosis the result of cicatricial contraction of ulcer, in which by the use of the knife the narrowed orifice is enlarged, has been performed 4 times with but 1 death. It would appear, therefore, a promising surgical procedure for the relief of simple cicatricial stenosis; but it is not yet time to speak with any degree of positiveness as to its value compared with that of the other better-tested methods in use.

As regards comparative mortality attending operations for the relief of symptoms of stenotic dilatation, whether cancerous or non-malignant, gastro-enterostomy, since the introduction of Senn's apposition bone-plates or some of their modifications, is apparently more deserving of consideration than any of the above-mentioned procedures. Even in carcinomatous stenosis the death-rate under it is comparatively low, and, as suggested by Weir,[3] will very likely be still less, performed for the relief of obstruction not dependent upon malignant disease, in which a cancerous cachexia is not superadded to that induced by inanition alone resulting from gastrectasis. Nutrition in most cases of gastro-enterostomy seems to be adequately preserved, unless the anastomosis is effected at a considerable distance from the duodenum.

In all cases of non-cancerous stenosis subsequent to removal of the obstruction to the onward passage of food into the bowel, if the stomach does not tend to regain its normal size and functions, efforts should be made to promote these by the employment of methods suggested in another part of this article.

[1] *Medical News*, May 25, 1889. [2] *Deutsche med. Woch.*, Feb. 28, 1889.
[3] *Medical News*, Feb. 14, 1889.

CHOLERA MORBUS, CHOLERA, CHOLERA INFANTUM, AND DYSENTERY.

By FREDERICK A. PACKARD, M. D.

Under the name of "cholera" are included several diseases that, having some symptoms in common, differ widely in their etiology, prognosis, and treatment. Differing as they do so essentially, it will be necessary to speak of each affection separately, although in many the means of treatment employed are identical.

CHOLERA MORBUS.

It seems scarcely necessary to enter into an elaborate discussion of the prophylaxis of an ailment the lighter grades of which are so universally experienced. As every school-boy knows how to account for his attack of colic when he has eaten unripe apples, and probably was aware of the risk that he ran when so doing, the physician is but seldom enabled to advise any precautionary measures. There is one point, however, that should be borne in mind—the fact that chilling of the surface, by causing congestion of the digestive organs, may render indigestible an otherwise harmless article of diet. From this fact we may frequently account for the peculiar attacks of suddenly developing, griping, colicky pain, shortly followed by vomiting and copious semifluid evacuations, that are so often seen in this climate during the latter part of August and in September, when we have the combination of hot days and cool evenings.

The lesson here is manifest. In such people as are predisposed to or have suffered from attacks of intestinal disturbance chilling of the surface must be carefully avoided. For those who suffer from this liability there is no protection so perfect as that obtained by the wearing of a woollen bandage about the abdomen and loins. This class of people, as a rule, soon learn the bitter lesson of experience, and discover what articles are apt to upset their digestive equilibrium; this, however, should not prevent our laying down the necessary

rules as to their diet. To those so predisposed there should be given such general rules as are suited to the particular lesion of the stomach or intestines from which they are suffering. Among the numerous articles that are apt to cause such acute choleraic attacks are—green fruit of all kinds, cucumbers, chestnuts, and all such combinations of foods as by their presence in the stomach may produce an indigestible mass. Even milk, usually so readily digested, may become harmful when taken into the stomach in too large mouthfuls, or when, by the addition of acid food in the stomach, it is curdled into a hard mass instead of into flakes. The ingestion of large amounts of water after very intense or long-continued thirst is capable of bringing on an attack. For this reason the advice should be given that limited quantities of water should be taken, and the fact pointed out that the same relief may be obtained by sipping water as by swallowing it in huge mouthfuls. Impure drinking-water may cause an attack of cholera morbus independently of the quantity taken, so that when called to a case suffering from this disease the water-supply should be investigated, in the absence of a more palpable cause, lest others in the household may suffer in like manner.

When called to see a case of cholera morbus, our first inquiries should, of course, be directed to the discovery of the cause. Having learned that unsuitable food has been ingested, we should determine whether any of it still remains in the stomach, or whether that organ has been emptied either by vomiting or by the passage of the offending material into the bowel. Should it be found to be probable that any of the indigestible article or articles still remains in the stomach, emesis should be induced by the ingestion of lukewarm water with or without powdered mustard. If the stomach has already been emptied, our first care must be to remove as rapidly as possible all irritating material remaining in the bowel. For this purpose a readily available, prompt, and often most grateful means of relief will be found in the use of a large enema of water just hot enough to be bearable, to which may be added a table-spoonful of turpentine. Should this be ineffectual, more time must be taken for the production of complete relief, and we have meanwhile to render our patient more comfortable. Externally, the most effectual applications will be found to be repeated hot turpentine stupes or a large strong poultice of mustard flour over the abdomen. Lebert recommends the raising of a large blister over the epigastrium, either by means of ammonia or the hot iron, in those cases that are very dangerous and run a rapid course, and advocates the endermic application of morphine to the surface so denuded. To relieve pain, morphine with atropine by hypodermic injection will act most quickly, or we may prescribe the former by the mouth in some such mixture as the following:

℞. Morphinæ sulphat., gr. $\frac{1}{6}$;
Spiriti chloroformi, ♏xxx;
Mucilaginis acaciæ, fʒj;
Aquæ menthæ piper., q. s. ad fʒij.—M.
Sig. One half of this mixture to be taken in a table-spoonful of hot water.

Or we may combine tincture of ginger with the morphine.

By this combination of internal and external measures relief will usually be speedily obtained, giving us time to remove the exciting cause. For the latter purpose there is nothing so effectual and harmless as the administration of from $\frac{1}{2}$ to 1 ounce of castor oil, to which 7 drops of deodorized tincture of opium have been added. By this means we remove the offending material from the bowel without adding to the already existing irritation.

To allay the vomiting, if marked, we may employ small pieces of cracked ice or carbonated effervescing waters, or the following mixture:

℞. Creasoti,
Acidi hydrocyanic. dil., *āā.* ♏ij;
Mucilaginis acaciæ, fʒss;
Aquæ, q. s. ad fʒj.—M.
Sig. To be taken at one dose.

While we wish to empty the bowel of its irritating contents, it may be necessary to check the excessive excretion from the bowel-walls in cases in which exhaustion threatens from this source. By employing nitrate of silver in doses of $\frac{1}{6}$ to $\frac{1}{4}$ grain every two, three, or four hours we may accomplish our purpose without hindering the laxative action of the castor oil.

Should collapse appear imminent, free stimulation may be necessary by means of brandy or ether, combined with the application of external heat. For the painful cramps of the extremities that are at times present dry friction with the hands and the application of hot bags of salt or sand will be found most useful.

For the first eight or twelve hours after the onset of the attack nothing in the way of nourishment should be given; but should there be objective or subjective weakness hot brandy and water, with or without small doses of ginger, may be given according to circumstances. If vomiting persist and stimulation be still required, small quantities of dry champagne may be used.

At the end of the time mentioned above small quantities of milk, diluted with gradually diminishing quantities of hot water, and guarded by lime-water in the proportion of a table-spoonful to 4 ounces of milk,

may be given at intervals of two or three hours. Meanwhile, either the hot applications should be retained on the abdomen or a layer of cotton batting or a thick pad of flannel should be applied.

After the acute symptoms have subsided there is usually left a certain amount of irritation or actual inflammation of the gastro-intestinal tract. Any increase in the amount of food should therefore be cautiously made. Should there be much gastric disturbance, the patient can be easily nourished by partially peptonized milk alternating with small doses of liquid peptonoids. At the same time the following formula will be found useful in restoring the mucous membrane and glands of the digestive tract to their normal condition:

℞. Hydrarg. chlorid. mitis, gr. $\frac{1}{12}$;
Pulveris aromatic., gr. ij;
Extracti pancreatis, gr. v;
Bismuthi subnitrat., gr. x.—M.
Ft. pulv. No. 1.
Sig. One every three hours.

Should diarrhœa persist after the disappearance of the more acute symptoms, the intestinal mucous membrane may require more direct medication. For this resulting diarrhœa no drug is of so much value as the salicylate of bismuth in doses of 5 to 15 grains every three or four hours, with which may be combined either denarcotized opium, thymol, *α*-naphthol, or other intestinal antiseptic.

After the digestive tract has been restored to a more natural condition the dietary should be gradually increased, preference being given to such articles as are almost wholly digested by the gastric juice. Such variations in regard to the rapidity of return to the normal digestive power exist in different individuals that we must, to a great extent, be guided by the sensations of the patient as to the demand for increase in the amount of nourishment. We must not be in too much haste to increase the appetite by the administration of stomachic tonics, as the patient can readily live upon but little food while remaining at rest, and should too much work be thrown upon the stomach, a condition of irritability or actual inflammation may be continued. After the mucous membrane and digestive glands have been relieved of the more immediate effects of the storm through which they have passed, there almost invariably remains a condition of more or less atony of the former. At this stage the use of gastric stimulants may well be considered. The attempt to reawaken activity of the digestive apparatus should be undertaken with caution, in order that by progressively increasing the strength of our remedies we may gradually raise the tone of the affected parts without urging them too vigorously. The following prescription will be found useful:

℞. Sodii bicarbonat., gr. iij;
Extracti zingiberis fluid., ♏v;
Infusi gentian., q. s. ad f℥ij.—M.
Sig. Two tea-spoonsful three times daily.

In this formula the soda aids the secretion of acid by the stomach, the gentian acts as a local stimulant, while the ginger relieves the "coldness" of the vehicle. Later, say in four or five days, a stronger and more generally tonic mixture may be given, such as—

℞. Tinct. nucis vomicæ, ♏x;
Tinct. cardamom. comp., *vel*
Tinct. gentian. comp., q. s. ad f℥j.—M.
Sig. One tea-spoonful before meals.

Should constipation follow the attack, as is apt to be the case, an occasional enema of soapsuds and warm water will usually be found sufficient to relieve the condition. In cases in which the intestinal disturbance has been less marked and persisting, constipation may be well obviated by the use of 1-drachm doses of phosphate of sodium.

During the whole course of treatment, and for the succeeding week or two at least, a binder of thin flannel should be worn, not only to hasten recovery, but to prevent the troublesome subacute enteritis that sometimes persists. Should such a condition as has been just mentioned remain, careful regulation of the diet, with the use of small doses of nitrate of silver in pill form, will usually succeed in restoring the digestive tract to its normal condition.

EPIDEMIC CHOLERA.

ALTHOUGH but little can be said regarding the treatment of cholera during the attack itself, the disease offers large opportunities for saving life by prophylactic measures. The infrequent occurrence within late years of extensive epidemics of this disease has prevented very great advances in our means of treating it when present. It would, however, remove some of our feeling of powerlessness could we feel sure that our prophylactic measures were responsible for the decrease in the former frightful extent of the disease—that we had been able to avoid the necessity for using the pound of cure by the employment of the ounce of prevention. Such epidemics as have occurred have taught us valuable lessons in regard to prophylaxis, while the discovery of the comma bacillus as the probable cause of the disease has

not only explained many formerly obscure points in regard to the spread of epidemics, but has also taught us how more securely to limit it in its ravages.

Many of the predisposing causes of cholera are such that they cannot be remedied by any means at our command short of actual depopulation of a district. For example, it is well established that two of the most potent causes for the foothold obtained by the disease in certain localities are the existence of a shallow, porous surface-soil resting upon an impermeable basis, and the use of a tide-water system of drainage. The former of these cannot, as has been said, be entirely prevented, yet by proper regulations as to the contamination of the surface-soil and the providing of a suitable system of underground pipe-drainage the existing defect may be rendered far less of a menace in times of pestilence. In the matter of tide-water drainage probably ere long the political economists will more effectually appeal to the pockets of communities and arouse them to a sense of their physical welfare. The solution of the drainage question must sooner or later come in the form of a method of disposing of the sewage of large towns more economical and hygienic than are those at present in use.

Leaving these less easily accomplished means of averting the outbreak of the disease, we come to methods more directly within our control. The almost universal system of international and local quarantine has undoubtedly done more to prevent the spread of cholera than has any other single measure. The system at present employed in most countries has been so arranged that, while protecting the inhabitants in the threatened districts, as small an amount of hardship has been inflicted upon those already exposed as is possible The old principle of absolute penning in of the whole afflicted people, sick and well together, has been now so modified that the well may be separated from the ill without coming in contact with those who have not been exposed to contamination. That the former herding together of all who could by any possibility have become infected with those already affected was pernicious, is as true as is the fact that all those so exposed should be detained in an intermediate, probationary station before being allowed to enter healthy areas. During the prevalence of an epidemic, therefore, any one leaving the affected locality should be detained at some intermediate point for at least one week, in order to prevent him from developing the disease after removing to a previously uninfected community. All mail matter or other material that could act as fomites should be thoroughly disinfected by heat before being distributed to other regions.

During the prevalence of an epidemic much may be done to limit the extent of the calamity. At such times all the well-known hygienic

laws should be rigidly enforced. The collection of surface-water or of waste material in the neighborhood of dwellings or near the sources of water-supply should be thoroughly prevented. The organization of a sanitary corps for the carrying out of the necessary measures should be early effected. Besides attending to the enforcement of the matters already referred to, it should be the duty of such a police to close all wells or springs that are even suspected of being in danger of pollution either from surface-water or from cesspools.

All discharges from persons already afflicted should be disinfected, preferably by means of destruction by fire. Should such a means be unavailable, every precaution should be taken that these discharges may not be placed in shallow wells or flow into any stream which supplies drinking-water to other communities farther down its course, or which has an ebb and flow whereby the germs of the disease may be carried backward and forward with each returning tide. As soon as voided the discharges should be mixed with a strong solution of corrosive sublimate and buried at a distance from human habitation.

All excessive excitement, whether religious or otherwise, should be eschewed to as great an extent as is possible. Though panic is an evil to be distinctly avoided, no pains should be spared to instruct the public as to the gravity of the affection, in order that the proper regulations of the sanitary advisers may be carried out. Much could doubtless be effected by proper public information in regard to the laws of diet, the necessity for the avoidance of indigestible articles, unripe fruit, or tainted food, while the importance of heeding any diarrhœal attacks, however slight, should be insisted upon. Particularly should warning be given against excesses in drinking, since it was found in Germany during an epidemic in 1831 that, owing to Monday's excesses, the largest number were attacked on Tuesday, and the least on Saturday.

Should cholera attack one of the inhabitants of a house, all those exposed to similar danger by the use of the same supply of water should be warned to obtain their water elsewhere, or, if this be impossible, should be urged to subject that used for drinking and cooking purposes to prolonged boiling. Where practicable, all of the inhabitants of an infected house should remove to other quarters, whether the patient remain or be removed to a hospital.

To those in charge of a patient ill with this disease special instructions should be given as to the carriers of infection, due warning being given in regard to the avoidance of the ingestion of even the slightest particle of the infecting agent. The most scrupulous care in keeping the hands not only cleansed, but actually disinfected, should be insisted upon. The best method of attaining this end is undoubtedly by the free use of bichloride-of-mercury solutions as a supplement to ordinary washing. All bedding, napkins, etc. should be soaked in bichloride

solution or boiled before being sent to the laundry. The use, whenever practicable, of articles of but little value is to be commended, as they can be destroyed by fire immediately upon being discarded. The evacuations from the bowels should be thoroughly disinfected immediately upon reaching the receptacle into which they are passed, or if the fæces be passed in the bed the clothing shonld be renewed and the soiled articles burnt, boiled, or soaked in strong corrosive-sublimate solution.

After the attack is over all articles that could have become infected should be carefully subjected to one of the processes mentioned—boiling, burning, or soaking in antiseptic solutions. Could every community have some public oven where, in time of pestilence from whatever disease, all articles of too much value to be destroyed might be subjected to prolonged baking, much might be saved that otherwise may either be rendered valueless or become the source of other cases of the same disease. Such ovens would soon save as much as the first cost of the apparatus.

In regard to the individual, much can be done to avoid the danger of infection. Peace of mind, to as great an extent as is possible in such times of anxiety, is very important. Care in diet, without reduction in the amount of food taken to such an extent as to depress the vitality, is of the utmost importance. The eating of manifestly indigestible articles, unripe or over-ripe fruits, vegetables and meats that are not perfectly fresh, should be carefully avoided. Any slight tendency to diarrhœa should receive prompt attention, and, while laxatives should be but sparingly used, constipation must not be allowed to exist for any length of time. Beyond this, attention to the ordinary laws of hygiene will tend to postpone or prevent the development of an attack.

In treating an individual already attacked by the disease we must be chiefly guided by the symptoms presented. There is no specific remedy for the disease, though many have been brought forward as such. Besides symptomatic treatment our reliance must be put on opium or morphine. During the prodromal diarrhœa the use of these drugs should be early adopted. After the attack is fully developed but little effect can be obtained from drugs, owing to the failure of the mucous membranes to absorb and the lymphatic vessels to carry anything that may be given.

For the severe abdominal pains that are so frequently present counter-irritants over the surface of the abdomen may be used, in addition to the employment of the narcotic. During all stages of the disease, except that of reaction, free stimulation may be called for, and is usually best attained by alcohol, ether, or camphor. The hypodermic use of strychnine might be of value in overcoming the profound depression of all the vital forces, it being a stimulant and tonic to the respiratory, cardiac, and central nervous systems. During the algid stage external warmth, either in the form of hot bottles or cans or the warm

bath, may be necessary. When the intestinal discharges are sufficiently profuse to destroy life, the addition of astringent remedies may be of value. Of these may be mentioned tannin and aromatic sulphuric acid. The internal remedies that are supposed to produce asepsis of the bowel have not as yet received sufficient trial for us to estimate their value, though salol has been used with some measure of success.

Owing to the tremendous drain of fluids from the body, it was at one time very naturally suggested that the intravenous injection of saline solutions might be of value. Unfortunately, however, the results of this method have not justified the hopes entertained in regard to it.

There is one apparently trivial point that should always be remembered in treating a case of cholera—viz. the importance of using the catheter where any doubt exists as to the bladder being empty.

For the painful cramps that are such a prominent feature of the disease nothing will be of much avail, but some comfort may be given by gentle friction with the hand.

During the period of reaction our treatment must be based upon general principles, and must vary with any local lesions and their seat, as would be the case were there any other primary cause. In regard to diet but little need be said. The stomach will probably not retain or the absorbents take up any nourishment during the greater part of the illness. If food can be retained, concentrated and at the same time most nourishing articles should be chosen. Carbonated effervescing waters may be allowed, and cracked ice may be given to relieve the distressing thirst.

During the stage of reaction great caution must be exercised in the matter of diet. Milk, especially if pancreatized, may be given in small quantities. During convalescence the diet should be carefully increased from pancreatized milk to milk with lessening quantities of barley-water, plain milk with lime-water, soft diet (including milk toast, raw egg and sherry, beef-juice, scraped beef, etc), adding article by article until convalescence is complete and the ordinary diet resumed.

CHOLERA INFANTUM.

While to a certain extent a preventable disease, some of the most efficient factors in the production of cholera infantum are practically beyond our control. In large cities the disease in this climate will claim very many victims in spite of our most energetic efforts. The conditions of life in towns are such as strongly to favor its develop-

ment, and it is surprising that any of the infants residing in the poorer sections of our cities manage to escape the disease. When one walks through the "slums" of a city during a hot spell, sees the squalor in which the poorer classes exist, smells the foul odors arising from every gutter and inlet, sees milk exposed for sale in the smaller shops without proper means for keeping it from spoiling, and babies tugging at the nipples of foul nursing-bottles with six or eight inches of fouler rubber tubing, the frequency of the occurrence of the disease cannot be wondered at.

It would be an interesting study should some one engaged in bacteriological work expose for varying lengths of time test-tubes filled with sterilized milk over one of the inlets found at our street corners, and note with what rapidity the milk may become infected. A short exposure would probably suffice to render such food far from sterile. For such a condition of our streets the responsibility must be laid in part upon our street-cleaning bureaus, in part upon the inhabitants themselves. Filthy gutters filled with refuse from the table and kitchen, exposed to a hot noonday sun, soon form breeding-places for almost all species of micro-organisms. It cannot be wondered at that in the neighborhood of such foci milk should soon spoil and infants absorb germs of disease from the atmosphere.

While such a condition of affairs will always be present in towns of sufficient size to have areas inhabited solely by the ignorant poor, we can even in these districts do something toward moderating the chances of an infant contracting the disease. If street-cleaning bureaus and boards of health cannot render a whole neighborhood sanitary, individual householders may be taught the well-known method by which the "streets of Jerusalem were kept clean."

Foremost among the means of preventing the onset of cholera infantum is care in diet. The inability to obtain perfectly fresh milk in cities may be, to a certain extent, compensated by the thorough boiling of the daily supply immediately upon its receipt. This, however, is not alone sufficient, as the milk must be kept sterile until used. Where ice can be obtained and carefully cleansed covered receptacles are in use, this matter can easily be arranged; but in a large class of our town populations ice is an unattainable luxury, while the lessons of cleanliness have never been learned. With such as these preventive measures can hardly be adopted. Frequently have I been told that the infant's milk-supply was placed in the cellar "to keep it cool," and on going into the cellar found it so reeking with the odor of sewer-gas and mould that the living-room of the family seemed sweet and clean by comparison. With such people as these it is usually found that all our directions will be of no avail, and that if the milk-can be not kept in the cellar it will be hung on the back fence near to a foul privy-

well. In these circumstances the best that can be done is to have each bottleful of milk placed in boiling water, after being made up and before using. This, being an additional source of trouble to the probably already overworked mother, will be either neglected entirely or else performed improperly; but we should endeavor to have it accomplished.

Many an attack of cholera infantum owes its existence to the death-carrying long rubber tubes sold in the shops as substitutes for the ordinary old-fashioned glove-finger nipple. No matter how much care may be used in cleaning these tubes, it is impossible to be certain that they are absolutely purified, and frequently they are almost occluded by foul-smelling masses of decaying milk that can be only with difficulty extracted by a strong stream of water or a piece of wire. The more old-fashioned plain nipple, that can be turned inside out and scrubbed, is not only cleaner and more safe, but it is also much cheaper. The great disadvantage that it possesses from the care-taker's point of view is that the child cannot keep on sucking it indefinitely without attention—surely a most beneficial fault. Aside from these sources of disease, the food, even though safely preserved, may be given improperly prepared, in improper quantity, or at too short intervals.

It would take up too much space in an article of this character to go at length into the question of the preparation of food for children of different ages, this being well discussed in the books upon infant hygiene and feeding. It may be proper, however, to insist here upon the fact that thirst may be the cause of the eagerness displayed by an infant for its bottle as often as is actual hunger, and that, during the hot summer months particularly, plain water should be supplied to the infant at regular intervals, in order that the stomach may not be filled with nourishment and compelled to strive to digest food when only water is demanded. The frequent practice of feeding infants "whenever they cry," or of allowing an infant to lie with the long rubber tube from a nursing-bottle constantly in its mouth, cannot be too strongly deprecated. Many an attack of colic that may be merely the forerunner of cholera infantum might be cut short were some carminative, such as a few drops of aromatic spirit of ammonia in a teaspoonful of hot water, given, instead of temporarily easing the child's pain by adding to the flame fuel in the shape of warm milk.

Aside from being indirectly an etiological factor from its increasing the contaminating elements of the food-supply, high external temperature alone seems to be capable of originating the disease. In no other way can be explained the fact that cholera infantum does at times attack the children of well-to-do parents where every precaution has been taken to avoid the introduction of germs into the food-supply. While, there-

fore, improper drainage, filthy surroundings, improper care of the food-supply, and improper manner of feeding may precipitate an attack where otherwise it would not have occurred, the less preventable cause, high atmospheric temperature, cannot be avoided save by change of habitation. On this account children should, whenever it is possible, be either wholly removed from the heated city during the hot spells, or, if this be impracticable, should be given a breath of fresh air in the park or on the river so soon as the sun has lost some of its power as evening approaches. The establishment of public parks and the running of river excursion-steamers permit almost the very poorest to avail themselves of the opportunity to obtain at least a small amount of better and cooler air for their children. The same end is also accomplished by the numerous charitable associations that send mothers with their sick children to the seashore or country.

Teething children are especially apt to be attacked, owing to the accompanying irritability of the gastro-intestinal tract, and to the fact that children during dentition have, as a rule, less power of resistance than at other times. Early lancing of the gums, therefore, is imperatively demanded during hot weather.

When an attack of cholera infantum has already begun, prompt action is necessary. Wherever it is possible the child should be immediately removed to the seashore or country. This removal may be the means of saving its life without recourse being had to any medication. If it is impossible to take the patient away from the city, the coolest and best-ventilated room in the house should be selected for its occupancy. The child should be lightly clothed, and allowed to lie on a bed or in a hammock, instead of being held in the lap of its mother or nurse.

The diet must be carefully regulated to the age of the patient, milk being given with much more diluent than is necessary for a healthy child of the same age. If vomiting be a marked symptom, it is better to withhold all food until this symptom is subdued, the child being merely given frequent sips of barley- or rice-water.

In regard to external measures we must be guided by the condition of the individual case. When the temperature ranges near to 105° F. frequent sponging with cool water, to which has been added vinegar, alcohol, or whiskey, will not only comfort the patient, but will also give material assistance toward cure. Should collapse be marked and the temperature subnormal, the reverse holds good, and external warmth in the shape of hot blankets, hot bottles, or hot bricks should be employed. When the extremities are cold and livid, heat should be applied to the feet, even though the high internal temperature calls for cool applications to the rest of the body. Should the temperature remain high or progressively rise in spite of cool sponging, a wet

pack, made by wrapping the child in towels wrung out of cold or iced water, should be applied as often as may be necessary. Centripetal friction of the extremities will aid in maintaining the circulation, which is, as a rule, very sluggish. Thirst, which is usually urgent, may best be relieved by the frequent sipping of water or the swallowing of small pieces of cracked ice. While plenty of water should be given to make up for the waste occurring in the intestinal discharges, care should be taken not to overload the stomach and thereby provoke or intensify emesis.

For the purpose of supplying the waste of fluids from the body it has been proposed to employ large enemata of water—a plan that is said to act well by those who have used it. Large enemata of water containing creolin in the strength of 1 drachm to the pint have been used with advantage, not only for supplying the additional amount of fluid, but also for the purpose of directly medicating the colon.

Internally we should employ stimulants freely, using brandy, whiskey, or curaçoa. The amount required will vary with the age of the child and the need of cardiac stimulation. From 5 to 30 drops may be given every hour or two. When actual failure of the heart is imminent, carbonate of ammonium in doses of $\frac{1}{2}$ grain to 2 grains may be necessary, but it is apt to increase the vomiting. For the latter symptom we may use cracked ice internally, sinapisms to the epigastrium, lime-water, or the following prescription:

℞. Creasoti, ♏ $\frac{1}{8}$;
Bismuthi subnitrat., gr. iij;
Mucilag. acaciæ, ♏xx;
Aquæ cinnamomi, q. s. ad ʒj.—M.
Sig. Shake well. Take this amount at one dose.

For the diarrhœa we may use several different remedies or combinations of remedies. Opium may be employed, either in the form of one of the preparations made from the crude drug or in that of one of the salts of morphine. The latter form is the better, owing to smallness of bulk and its more certain retention by the stomach. From $\frac{1}{300}$ to $\frac{1}{200}$ grain of sulphate of morphine may be given, combined with aromatic sulphuric acid, and repeated every two, three, or four hours, according to the age of the child and the effect produced.

Salol was but lately strongly recommended for the control of the diarrhœa of cholera infantum; but during the past summer I have obtained very good results by the use of salicylate of bismuth. This has, in the few cases in which I have been able to use it, had a most beneficial effect on both the vomiting and the purging, whereas I found but little good effect from salol when I used it during the preceding summer.

In one hospital, with which the author of this paper is connected, all drugs, dispensed without cost, are prescribed according to a formulary, and from this the two following formulæ were prescribed in combination, oftentimes with astonishing results. The two formulæ are numbered (9) and (54), and are combined in the proportion of 1 part of the former with 3 of the latter. The formulæ are as follows:

(9.)

℞.

Acidi salicylic.,
Sodii bicarbonatis, āā. gr. v;
Aquæ, ℥xl;
M. et adde,
Tinct. aurantii cort., ℥v;
Glycerini, ℥xv.

(54.)

℞.

Bismuthi subnitrat., gr. vj;
Tinct. opii deodorat., ℥j;
Syrupi, ℥xx;
Mist. cretæ, q. s. ad fʒj.

This has, as has been said, given most excellent results in doses of 1 tea-spoonful every three or four hours. The formulæ can well be condensed into the following:

℞. Tinct. opii deodorat., ℥j;
Acidi salicylic., gr. ij;
Sodii bicarbonat.,
Bismuthi subnitrat., āā. gr. ij;
Tinct. aurantii cort., ℥v;
Mist. cretæ, fʒss;
Aquæ, q. s. ad fʒj.—M.

Sig. To be taken at one dose.

After a few doses the stools lost much of their serous character, became less offensive, more highly colored, and, in favorable cases, returned to the normal character, when the other symptoms could be mitigated sufficiently to permit of life being maintained. The salicylate of bismuth may be given in doses of 2 or 3 grains in powder every two, three, or four hours. The use of opiates requires caution, and their employment should be entirely suspended upon the appearance of stupor or coma.

Where this latter symptom arises, it might be justifiable to resort to the use of intravenous injections of saline solutions, in order to attempt to increase the fluidity of the blood, and so permit of its proper circulation through the blood-vessels.

If the patient weather the storm, removal to the seashore or country should be again urged, as relapses may readily occur. The return to the normal diet should be slowly and very gradually accomplished, while the intestinal tract will require judicious medication to

overcome the resulting inflammatory conditions that are almost invariably present.

DYSENTERY.

ALTHOUGH dysentery will probably never be justly placed upon the list of preventable diseases, much can be done in our endeavor to make it so. The frightful ravages that have so frequently occurred from the appearance of this disease among troops and garrisons have led to careful investigations as to its predisposing and exciting causes. Some of these have been discovered, and may be, to a great extent at least, avoided. That in the *Amœba coli* we have the true, immediate cause cannot as yet be asserted with any great degree of certainty, but further experiments and investigations may throw light upon the question of its etiological importance that will aid us in our attempts at prophylaxis.

There would seem, in the present state of our knowledge, to be several factors in the causation of the disease that may be at work separately or together in individual cases. It is certain that, in this climate at least, more cases occur in the late summer and early autumn months than during any other time of the year. Whether this be due to the fact that during this period we have the combination of warm days and cool nights with much moisture, or to the abundance at this season of various fruits that may readily spoil, or to a combination of these circumstances, cannot be considered as definitely settled. The fact that the disease frequently seems to be induced by impurity in the water-supply would not account for the special prevalence of the disease during the above-mentioned period of the year, unless we presume that the noxious water may be infected by an organic poison whose period of greatest activity occurs at this time.

Although, as has been stated, we have no definite proof of the Amœba coli being the chief cause of the disease, we may safely determine to prevent, so far as is possible, its entrance into the system, if only upon general principles. Further discussion upon the etiology of the disease would be out of place in an article upon treatment, but so much has been said in order to draw attention to a few of the points of importance in the matter of prevention.

In order to avoid the results of contaminated water-supply, careful filtering and prolonged boiling of the water to be ingested should be universally adopted. These precautions are not difficult to adopt, and should be taken as a matter of necessity where any doubt can possibly be thrown upon the purity of the drinking-water, whether in regard to the danger of the onset of dysentery or not. Should

many cases of this disease appear in any locality, these measures should be more carefully practised owing to the likelihood of a common source of poisoning. From the apparent distant relationship between dysentery and malaria it is wise to avoid the use of water that is derived from springs in marshy ground, where the water may remain stagnant, poorly exposed to the influence of oxygen, and contaminated by decaying vegetable matter. When one sees the Amœba coli simulating exactly its larger non-pathogenic congener, whose favorite habitat is in just such collections of vegetable infusions, the possibility of an analogy in their life-habits cannot fail to impress the observer with the thought that stagnant water contaminated by vegetable impurities may play a large part in the causation of the disease.

That the fæcal evacuations of a case of dysentery may carry infection is very far from unlikely. For this reason great care should be exercised in regard to the disposition of the excretions of existing cases. Particularly should the use of shallow pits and privy-wells be carefully avoided, chiefly on account of the danger of contamination of the water-supply from their superficial position and consequent liability to be flushed out over the surrounding ground surface by each heavy rain. Another possibility has been suggested, though it seems somewhat of a refinement—viz. the danger of the disease-poison being drawn into the rectum by the alternate relaxation and contraction of the muscles around the lower end of that structure during defecation into or over such pits as have a meagre distance between the surface of their contents and the level of the ground. This, as has been said, seems to smack of too much refinement in etiology; but, for the other reasons mentioned and on account of the well-recognized evil of shallow pits for the reception of fæcal matter, their use should be entirely avoided.

The part played by the eating of unripe, over-ripe, or spoiled fruit and vegetables cannot be more than an auxiliary cause, as the same materials are eaten during the earlier parts of the year, though possibly not to so great an extent, without so frequently causing the symptoms of a genuine attack of dysentery. It would seem, therefore, that as regards dysentery the use of unsuitable food should be avoided, on account of its liability to produce irritation of the intestinal tract.

Chilling of the surface of the body seems to have some influence in at least predisposing to the disease, and should consequently be avoided, particularly by those who have either had a previous attack of dysentery or are the subjects of intestinal derangement. Fæcal accumulation strongly predisposes to dysentery, owing to the resulting irritation of the mucous membrane.

From these observations it will be seen that our strongest means of avoiding the occurrence of the disease are those that are manifestly connected with ordinary care in personal and public hygiene. In spite of

all our care, however, it is still possible that we may never be able absolutely to control the causes of the disease.

The treatment of a person already attacked by dysentery must vary very much in accordance with both the local condition of the intestine and the general condition of the patient. In many otherwise insignificant cases the tormina and tenesmus may be intense, while frequently the cases that are suddenly struck down by a severe attack may feel and complain of but little discomfort. Our treatment, therefore, must be somewhat symptomatic, but we fortunately have a number of remedies that appear to have almost a specific action upon the disease-process. It will best answer our purpose to consider first the latter class, treating later of the methods to be employed for the relief of the various prominent symptoms.

Foremost among the remedies for which a specific quality has been claimed stands ipecacuanha. This remedy was formerly held in much higher esteem than at present, although it is still used, and with advantage, in some cases. The great disadvantage in its use is that it is impossible to foretell with certainty in what cases it will do good, and in what cases valuable time may be lost while attempting a cure by this means. The remedy has been particularly extolled by the physicians of India, where it may be that the well-known cholagogue action of ipecacuanha causes the good results by stimulation of the liver and intestinal glands in those who have not become acclimated to their new surroundings. The drug may be employed in one of two ways, of which the first mentioned will be found most efficacious in the greater number of cases. In using the drug by the first plan a full dose of 20 grains is given by the stomach, 10 or 15 drops of laudanum having been administered about thirty minutes previously, and repeating the dose in half an hour if the first be vomited, or in four hours if it is retained. The other plan is to give doses of 5 grains every half hour until the patient vomits, after which 10 or 15 drops of laudanum are given, followed by additional doses of ipecacuanha in quantities of 5 to 10 grains at intervals of two or three hours, the drug being introduced in pill form. The first plan will be found to act quickly, if at all; but as many of the patients are already extremely exhausted by their disease, the emesis may act prejudicially by reducing the vital power of the sufferer. It would therefore be safer in cases with marked prostration to endeavor to treat the disease by local and less trying internal remedies, lest the stomach be rendered so irritable by our efforts with ipecacuanha that even stimulants cannot be retained. As in this disease we are, by the nature of the case, prevented from using the rectum as a means of introducing stimulants and nourishment, we should endeavor to preserve the integrity of function of the stomach

most carefully. Therefore, although ipecacuanha is a valuable drug under some circumstances, there are other measures that may first be tried with advantage. Nitrate of silver has been extensively used with good results in the treatment of dysentery when administered both by the mouth and by the rectum. When given by the mouth it is usually combined with opium in the form of a pill, $\frac{1}{8}$, $\frac{1}{6}$, or $\frac{1}{4}$ grain being given every two, three, or four hours, with a quantity of opium varying in each case. This combination of the two drugs, while convenient, has the disadvantage that it prevents us from diminishing the amount of opium used as rapidly as is consistent with the comfort of our patient; whereas the silver should be continued for several hours after the movements have changed both as to frequency and character. For this reason it is, in the end, far more convenient to give the silver and opium separately. Personally, I have seen silver succeed in several cases in which all other means have failed after faithful trial, and should put greatest reliance upon it.

The following case shows very strikingly the effect of nitrate of silver, although a fatal ending was not averted: Hans L——, a Norwegian sailor, aged 52 years, was admitted to the wards of the Episcopal Hospital suffering from dysentery of one week's standing. He was a large, spare man, with pinched features, sunken cheeks, and a dry and fissured tongue that was protruded with difficulty through his parched lips. His teeth were covered with sordes. The extremities, tip of his nose, and ears were cold and livid, the abdomen was scaphoid, and the skin dry and harsh. Small mucous and bloody stools were being passed every few minutes, with much tenesmus. Brandy was at once given in doses of half an ounce each hour, hot cans were applied to the feet, and a large hot flaxseed-meal poultice was applied over the abdomen. As soon as the pulse, which was almost imperceptible upon his admission, had improved in quality, he was given an enema of two pints of cold water. This was repeated in an hour, with but slight effect upon the number of stools or the tenesmus. He was then given salicylate of bismuth, in doses of 20 grains every three hours, without any marked effect after several doses had been taken. One large creolin enema (1 drachm to a pint of cold water) was then given, but as no result was observable, he was put upon $\frac{1}{6}$ grain of nitrate of silver every three hours, while it was expected that another creolin enema would be given later. Although it seems impossible that so small an amount of silver should so rapidly affect such a large surface as the colon, the stools began to occur at shorter intervals, until, after the third dose, they ceased entirely. At this time the general symptoms also improved, while the patient declared that he felt much better. He appeared to be doing so well that no further local medication seemed necessary, while his stimulants were slightly diminished, owing to the improvement in the character of his

pulse. No further bowel movements occurred, and the patient's condition was apparently favorable, until he suddenly died twelve hours after the last stool had been voided.

It might be said that the improvement in this case was due to the bismuth already given or to the creolin enema. This I cannot believe to be the explanation of the rapid amelioration of his symptoms, as I have seen almost as rapid an effect produced by the same drug in cases in which a longer time could be permitted to elapse between other treatment and that by means of the nitrate of silver. That the sudden decrease in the number of his stools was not due to approaching death, as may at times happen, is shown by the marked contemporaneous improvement in his general condition.

Calomel has been much used in the treatment of this disease, with asserted excellent results. Whether its good effects are due to its cholagogue, purgative, or antiseptic properties it is difficult to say; but, judging from the beneficent action of ipecac (also a cholagogue), it would seem that the former is the true explanation of its effect. Opium has been largely—much too largely—used in treating this affection. As in other intestinal affections, we should bear in mind the fact that Nature never cures inflammation by "locking up" the secretions, but that the free discharge of serum from the affected area is the method of relief that is always most successful. We should give opium until the patient's sufferings are relieved, but when we go beyond that point or give the drug for any other purpose, we may hide the manifestations of the disease while increasing its virulence. It is not often that a patient is worn out merely by the pain of a dysenteric attack, and, in fact, it usually takes but a small amount of opium to render him comfortable. For this purpose the drug is best given either by hypodermic injection in the form of morphine, or by the rectum in suppository or starch-water. If the pain be chiefly referred to the anal region, this will ease the pain; but in cases in which there is much tenesmus a suppository consisting of $\frac{1}{2}$ grain of opium with $\frac{1}{4}$ grain of extract of belladonna may be of more value. If the pain be merely that of the tenesmus, we can use local measures, as will be mentioned subsequently, that are just as efficacious, without possessing the disadvantages of opium.

In some epidemics of dysentery quinine by the mouth has been used with advantage. This applies more particularly to those forms seen in camps and on the march, where undoubtedly the chief advantage has accrued from the influence of the antiperiodic upon the malarial poisoning that is almost invariably associated with, if not in part the cause of, the disease. It should in such cases be given in full doses. During the late Civil War in this country this drug was used in large quantities, both as a preventive and curative measure. In the

sporadic cases that occur during times of peace in our latitude it is difficult to see how the drug can be of the slightest advantage; and in fact it is practically never so used save for its generally tonic effect after convalescence has commenced.

Sulphate of magnesium has been quite extensively employed, and has proved of great value. It is chiefly of use in cases with small mucous and bloody stools evacuated with great pain. It is best given in saturated solution, 1 drachm being administered every two or three hours until the stools become of an almost normal color and consistence. A combination of this drug with aromatic sulphuric acid (10 or 15 drops) is often rather more beneficial. After the character of the stools has changed to more nearly that of the normal, a combination of sulphate of morphine with aromatic sulphuric acid will frequently complete the recovery. To disguise the taste of the saline a little extract of liquorice may be added. The treatment by a saline purgative of a disease in which the movements are so frequent as they are in dysentery seems at first thought rather inconsistent; but when it is considered that it is usually not the actual size of the stools which causes danger; when the physiological action of sulphate of magnesium in draining away or locally abstracting serum from the congested vessels of the inflamed intestine is remembered; and, above all, when one sees the stools soon become more natural and the other symptoms steadily subside under the use of this drug,—the supposed inconsistency is no longer apparent.

Should hæmorrhage be marked, the use of ergot is advised by some authors; but it will usually be found that the same result can be better attained by topical treatment in the form of large enemata, as will be mentioned subsequently.

Externally we may employ large poultices of flaxseed or flaxseed and mustard, or we may apply spongio-piline wrung out of hot water. These will be grateful to the patient, and may have some slight effect upon the course of the disease.

Many of the remedies administered by the mouth can act in no other than a purely local manner upon the affected area. This is true of bismuth, tannin, and numerous other drugs. It is therefore much more rational to attempt to obtain this local action by the direct application of the remedy to the seat of disease. This can readily be accomplished by the use of enemata, whereby we not only save the stomach, but are also able to determine more accurately the amount of the drug that reaches the objective point.

Simplest among these remedies are enemata of pure water. These can be used either at the temperature of ice-water or at 102° F. The choice of temperature may be in part made by a consideration of the

general condition of the patient. If there be subnormal temperature with other symptoms of collapse, as is often seen in hospital practice, where patients apply for admission late in the course of the disease, hot water is preferable; but if the general condition of the patient is sthenic, better results may be expected from the use of cold. These enemata should be *large*, each consisting of from 2 to 3 pints, and are best introduced from a gravity syringe, the reservoir being held about a foot or eighteen inches above the level of the patient's body. As a rule, the anus is extremely sensitive, and it is therefore important to use a blunt-pointed nozzle, to have it well anointed with some lubricant, and to effect its introduction very slowly and gently. Should there be much suffering caused by the introduction, a suppository of opium and belladonna may precede the use of the syringe, or the parts may be painted with a solution of cocaine. The patient should lie upon the back, slightly inclining toward the left side, and with the hips elevated. Should pain be experienced during the injection, the current should be stopped, being again allowed to flow so soon as the pain has diminished. That these injections cannot be safely made without care is shown by a case reported by Ball, in which acute diffuse peritonitis followed immediately after the injection of a pint of salicylic-acid solution into the bowel of a child suffering from dysentery. In this case none of the fluid returned, and, although recovery ensued, it is more than likely that some weakened portion of the intestinal tube gave way into the peritoneal cavity. This accident may be best avoided by holding the reservoir of the injection apparatus but a short distance above the patient, and by temporarily withdrawing pressure upon complaint of pain. The danger of perforation is of course greater the further the disease-process has advanced.

Numerous medicaments have been used to increase the benefit derived from large enemata. Among these are alum (1 drachm to the pint), creolin (1 drachm to the pint), corrosive sublimate, quinine, and nitrate of silver. Of these I have personal experience with none but creolin. I have used it in a moderate number of cases with much benefit, the stools decreasing in frequency, their character becoming more natural, their odor less offensive, tenesmus practically abolished, and the patient much more comfortable after one or two of the injections at intervals of four hours. In one or two cases this method failed to do more than slightly ameliorate the pain and lessen the odor of the stools. Alum enemata may be given in the strength above indicated. They have been highly recommended by many observers, and the benefit derived from their use would seem to be most marked in the strongly hæmorrhagic cases. Corrosive sublimate may be used in 1 : 5000 solution, of which 7 ounces are to be injected two or three times daily. This method has the disadvantage that but a small quantity

of the solution is used, thereby losing the advantage derived from flushing of the whole colon. Quinine may be used, according to the plan adopted in the Johns Hopkins Hospital, in solutions of 1 : 5000 strength. Large injections of nitrate of silver in the strength of 10 grains to 1 drachm in a pint of water may be employed, but they are more often of use in the chronic than in the acute form of the disease.

Other local means may be adopted to cure or to relieve distressing symptoms. Iodoform suppositories of 5 grains each will greatly relieve the tenesmus, frequently acting as quickly as opium, without any of the disagreeable effects of the latter drug. Suppositories of ice, made by moulding a piece of ice by means of friction into the conical shape of an ordinary suppository, are often a source of great relief when introduced at short intervals; more than a palliative effect cannot be claimed for them. Should hæmorrhage be very marked and the blood of a bright color, suppositories of tannin (5 or 10 grains) may be sufficient to control it, as the source of the blood in these cases is frequently within easy reach of the tannin as it becomes diffused over the rectal lining.

In almost all severe cases stimulation will be necessary. This can be best accomplished by alcohol in the form of brandy or whiskey. The amount to be given must depend upon the wants of each case, though larger quantities of stimulant may be employed than are usually administered in other affections, owing to the fact that a few hours may decide the favorable or unfavorable course of the disease, and because by free stimulation life may be maintained for a sufficient time to allow of cure by more direct treatment. An ounce of whiskey or brandy every hour, or even half hour, may be needed to keep the patient alive until the symptoms are subdued sufficiently to allow of reaction occurring.

The diet during the acute stage should be limited to milk diluted with water and lime-water, given in small quantities at frequent intervals. Raw egg, beaten up with sherry and a trace of nutmeg, may be given as a convenient form of nourishment and stimulant. Cracked ice may be allowed *ad libitum*.

After the acute symptoms have subsided and convalescence begun the diet should be cautiously increased until the usual articles have been added. A small and gradually decreasing amount of alcohol will usually be advantageous in hastening convalescence. Should the disease tend to become chronic, counter-irritation over the abdomen, care in diet, proper clothing, and the internal use of nitrate of silver in pill or by enema may be tried. In some cases change of climate may be needed ere the disease can be thoroughly eradicated.

There are practically but two complications that are likely to occur, besides those dependent upon the asthenic or typhoid state.

These are perforation of the bowel and abscess of the liver. The former is relatively of infrequent occurrence. Should perforation occur into the peritoneal cavity, a slender chance for recovery might be afforded by surgical measures. Unfortunately, these secondary abscesses are apt to be multiple, and consequently not curable by surgical means. The latter condition, abscess of the liver, can only be treated by surgical means in the same manner as would local collections of pus in other situations. None but general remedies can be of any avail when the abscess ruptures into the lung or digestive tract.

Should the disease subside into the chronic form, every effort must be made to improve the general condition of the patient by means of tonics, carefully-regulated and nourishing diet, and an abundance of fresh air. Hard pills of nitrate of silver and opium ($\frac{1}{6}$ grain of nitrate of silver combined with $\frac{1}{8}$ or $\frac{1}{6}$ grain of opium) should be given one hour after meals, while the silver salt may also be utilized in occasional large enemata consisting of 1 drachm to a pint of water. After using these injections the nitrate of silver should be neutralized by a large injection of chloride-of-sodium solution in order to obviate any danger of argyria. In addition to the points already mentioned, it is well to insist upon the wearing of a flannel binder. Counter-irritation over the abdomen will be of assistance, and may be best made by the use of tincture of iodine. The diet should consist of such articles as are digested by the upper portion of the gastro-intestinal tract and leave but little residue. Change of climate may be necessary in order to complete the cure of this oftentimes most obstinate condition.

OBSTRUCTION OF THE INTESTINES.

By EDWARD MARTIN, M. D.

Obstruction of the intestines may be caused not only by the mechanical closure of the lumen of the bowel, such as occurs in case of strangulated hernia, but also by certain pathological states, such as peritonitis or enteritis, which by occasioning a paretic condition of the muscular coats of the intestinal wall favors stasis, with resultant fermentation of the complex organic compounds contained in the alimentary canal and the development of typical symptoms of obstruction, accompanied by those of either inflammation or of septic absorption.

Clinically, cases of intestinal obstruction are classed as acute or chronic, depending upon the violence of the onset and the severity of the course of the disease. No sharp distinction can be drawn between the two, and each is liable to merge into the other.

Acute intestinal obstruction may be due to congenital malformation; to invagination or telescoping of one portion of the bowel within another; to internal strangulation by bands, diverticula, membranous adhesions, constrictions through apertures, or attachments of organs not in themselves diseased; to volvulus or twisting of the bowel; to impaction of foreign bodies; and to intestinal paralysis and distension.

Chronic obstruction is commonly due to stricture, to neoplasms, to pressure external to the bowel, or to impaction of fæcal masses.

Congenital Malformation.[1]

Narrowing or obliteration of the intestinal tract at birth may be found in any portion of the small or large gut. In the great majority of cases observed it is only in the region of the rectum or anus. Other seats of preference are the duodenum, the neighborhood of the ileo-cæcal valve, and the sigmoid flexure.

As observed in the lower bowel, this deformity may appear as a narrowing (partial occlusion), atresia (complete occlusion), or absence (imperforation) of the anus, of the rectum, or of both these structures. At times there is observed a stenosed opening in an abnormal position.

A careful statistical study of cases of congenital malformation shows

[1] For further consideration of this subject see article on Rectal Diseases.

that it is multiple in 28 per cent. of all cases, and that in 10 per cent. it is of such a nature as to be mechanically irremediable.

The symptoms of congenital malformation causing obstruction of the bowel are the same as those from obstruction dependent on any other cause. Shortly after birth fæcal vomiting, pain, and tympany, together with absence of evacuation from the bowel, will sufficiently indicate the nature of the attack, even though the malformation cannot be detected upon inspection.

The treatment of this condition is surgical. When atresia depends upon a thin membrane occluding the anus, a simple incision will give relief.

For imperforate anus the coccyx should be excised, and the bowel should be sought for by cutting upward and backward. The incision should not be carried deeper than an inch and a half at the most. If the bowel is found, it should be brought down to the skin wound and stitched in the position that the anus would normally occupy.

If the rectum cannot be found by this incision, the cut for left inguinal colotomy should be made. If the finger passed into the peritoneal cavity finds that the perineal incision can be safely deepened, with a condition of the rectum which will allow of its being drawn through this opening, the operation first undertaken should be completed and the inguinal incision should be closed. If, however, the conditions are such that an attempt to form a new anus is inadmissible—as, for instance, when there is complete absence of the rectum and atresia of the sigmoid flexure—left inguinal colotomy should be performed. The gut should be held in place, after suture of the skin to the parietal peritoneum, by a piece of rubber catheter passed across the wound and through the mesentery close to the bowel. Stitches should of course be inserted. Before securing the bowel in this way a digital examination should be made in the regions of the ileo-cæcal valve and duodenum, since malformation is frequently multiple, and these are the commonest seats of imperfect or arrested development.

If the obstruction does not depend upon atresia of the anus or rectum, exploratory abdominal section should be performed in the hope of finding the seat of trouble, and of remedying it by colostomy, enterostomy, or lateral anastomosis.

Intussusception.

The term intussusception implies that one portion of the gut is invaginated or turned within the lumen of another part immediately adjoining. This forms a tumor made up of three layers of bowel. The *intussusceptum* is composed of the entering and returning layers, while the receiving layer is called the *intussuscipiens* or *sheath*. Usually the

upper segment of the gut is received into the lower. "Retrograde intussusception" is a term applied to a condition the reverse of this.

The invagination may be *enteric*, involving the small intestines only. It may be *ileo-cæcal:* in this form the ileum and cæcum, together with the ileo-cæcal valve, are turned into the colon. It may be *ileo-colic:* in this form the ileum is prolapsed through the ileo-cæcal valve, the latter retaining its proper relative position until, as a result of secondary changes, it, together with the cæcum, is more or less displaced. It may be *colic*, in which case it involves the colon only. Or it may be *rectal*, the seat of trouble being situated entirely within the rectum.

Invagination in itself does not entirely occlude the lumen of the bowel. Complete obstruction, however, frequently results from swelling of the involved area, dependent upon constriction at the neck of the sac, and from lodgment of fæces. As a result of the inflammation excited by the constriction the serous surfaces of the entering and returning layers of the invagination frequently become adherent.

Invagination is one of the commonest causes of intestinal obstruction. In the first year of life obstruction from invagination is more frequent than from the sum of all the other causes occasioning this condition. After the fifth year intussusception becomes comparatively rare till the fortieth or fiftieth year, when it again increases in frequency of occurrence. The ileo-cæcal region is the favorite seat of invagination.

The onset of intussusception is characterized by sudden violent pain. After some time, usually a few hours in children, the pain ceases as suddenly as it commenced, and there is an interval of quiet. This is followed by a return of pain, the paroxysms becoming more violent and prolonged and the intervals becoming less marked as the disease progresses. Vomiting is an almost constant symptom. Its severity bears relation to the degree of obstruction rather than to its seat. Blood-stained mucous evacuations are rarely absent. In children diarrhœa is common throughout the whole course of the case. In connection with the muco-sanguinolent evacuations, tenesmus or straining is very marked. In more than half the cases a tumor can be felt in the left iliac region or by the finger passed into the anus. If this tumor is carefully observed, it may be found to have an erectile and a vermicular motion.

In the chronic form of invagination there may be no symptoms other than recurring paroxysms of pain, meteorism, and obstructive symptoms.

The mortality of intussusception as treated by the expectant method is about 74 per cent. The chances for life are best when the disease occurs at about the age of puberty. Sloughing and discharge of the

intussusception are favorable signs, since 41 per cent. of cases in which this occurs recover.

The treatment for intussusception may be either medical or surgical. The statistics of abdominal section for invagination give the mortality percentage as 75.4. There can be little doubt that in reality it is even higher than this, since there is a natural tendency to report only favorable cases. Abdominal section has usually been considered only after days spent in repeated and ineffectual efforts at reduction, when the patient's strength is far spent and immediate death is staring him in the face. Under these circumstances it is unfair to compare the statistics of operative cases with those treated expectantly, yet the mortality against the surgeon is less than 2 per cent.

Considering the class of cases in which section has been employed, any percentage of success would be encouraging; if resorted to when all conditions are favorable—that is, immediately after one thorough effort to accomplish reduction without operation—the percentage of recovery would probably be so high that even the most conservative would be disposed to recommend this form of treatment.

The medical treatment of intussusception is exceedingly simple. Morphine and atropine may be administered hypodermically in quantities sufficient to relieve the acute suffering. Lavage of the stomach may be practised if the vomiting is frequent and exhausting, and particularly if the eructated matter is very offensive. As a mild antiseptic boric-acid solution may be employed in place of water alone.

The pathology of intussusception shows that disinvagination becomes difficult in direct proportion to the length of time which has elapsed since the onset of symptoms; hence every hour that treatment is delayed diminishes the chances of success. Provided the case is not of such long standing that tight adhesions have probably made reduction impossible, or strangulation has produced a partial necrosis, ether should be administered to its full surgical extent, producing complete relaxation of the muscular system. By means of a fountain syringe a 0.7 per cent. saline solution at a temperature of 105° F. should be slowly forced into the rectum under a pressure of not over two pounds to the inch. (Elevation of the reservoir four feet.) The liquid is prevented from running out of the bowel by means of a shoulder upon the injection-pipe, readily made by wrapping the latter with a narrow bandage. The abdomen should be gently kneaded. This treatment should be continued for thirty or forty minutes, the pressure being gradually increased till it reaches eight pounds. This is obtained by elevating the reservoir sixteen feet. This trial at forced reduction must be thorough and final. There should be no idea that it is to be repeated with more care and attention to detail.

If there is a distinct tumor, the probable success of the method

above detailed will be denoted by its disappearance; the positive failure by the tumor occupying the same position as before treatment and retaining its full size. In the latter case the surgeon should proceed to operate at once, while the patient is still under the influence of the anæsthetic. In the majority of cases the success of this forced injection can be determined only by allowing the patient to come out of his ether; the progress of symptoms will then quickly decide as to whether a cure has been effected or not. Section should be performed the moment it becomes clear that invagination still persists.

When the severity of the symptoms and the amount of obstruction denote marked strangulation, and the patient has not been seen for several days from the onset of the attack, abdominal section should be the first resort.

If there is a tumor, incision should be made over it. In the absence of this sign the opening should be made in the linea alba below the umbilicus. When the invagination is found, it should be reduced by grasping the tumor at its lowest part and endeavoring by gentle continued pressure to reduce the venous congestion; then by traction from above and pressure from below the reduction will be much facilitated. If adhesions are formed about the neck, these may be broken up by a probe passed between the entering and returning layer and carried around the circumference of the bowel. If the adhesions are so tight that restoration of the gut to its normal position is impossible, unless the patient's strength is exceptionally well preserved, an enterostomy and the formation of an artificial anus will afford the best hope of recovery, since spontaneous resolution may subsequently take place with complete restoration of the continuity of the alimentary canal. Or by means of a lateral apposition the invagination may be entirely switched out of the alimentary tract. If gangrene has set in, resection with either the formation of an artificial anus, or in exceptional cases the performance of a lateral approximation, will be indicated.

Internal Strangulation.

Next to intussusception, internal strangulation ranks in order of frequency as a cause of intestinal obstruction. It commonly occurs in males between the thirtieth and fortieth years, and is in the great majority of cases due to the remains of a former peritonitis. It may be due to isolated peritoneal adhesions, to cords formed from the omentum, to Meckel's diverticulum, to normal structures abnormally attached, or to slipping of the gut through slits and apertures.

Internal strangulation may be sudden or gradual in development. Usually without cause there is sudden agonizing pain located about the umbilicus; this pain is constant, but has paroxysmal aggravations.

There is vomiting; this is constant, gives no relief to the patient, and becomes fæcal about the third day. There is constipation, which becomes absolute as soon as the bowel below the seat of obstruction is emptied. There is often localized tenderness and percussion dulness, which when present denote with some certainty the position of the strangulated bowel. There is some meteorism, and the pulse becomes rapid and weak. Unless inflammation develops the temperature remains about normal or a little below. The urine is greatly diminished in quantity and contains albumin.

The treatment of internal strangulation is obviously operative. Although a cure is possible, either by the rupture or absorption of the constricting band or by an intestinal anastomosis by ulceration, this result must be exceedingly rare when the condition of strangulation is fully established. Injection, massage, electricity, or any or all of the therapeutic means usually resorted to in cases of obstruction, can only by the merest accident be of the slightest avail. In any case of obstruction characterized by such fulminant symptoms as are common in strangulation, abdominal section with the idea of mechanically removing the cause of obstruction should be the first resort.

At times the onset of the malady is signalled by most profound shock; this may demand treatment before operation can be performed. External heat, full doses of morphine and atropine administered hypodermically, and whiskey by the bowel, 4 ounces diluted with eight times that quantity of hot water, offer the best hope of promoting reaction. Should the shock not yield to this treatment, and should the symptoms be steadily progressive, anæsthesia should be produced by the least possible quantity of ether, the abdomen opened, and a hurried search made for the seat of constriction. This should be relieved as rapidly as possible, and the peritoneal cavity should be flushed with hot saline solutions. If under these circumstances—that is, operation during profound shock—the seat of obstruction cannot be found, or if found the obstruction cannot be readily overcome, an enterostomy is clearly indicated.

When the patient is in good condition a free parietal incision should be made: the congestion and discoloration of the strangulated bowel, the distension above the point of occlusion, and the empty, flaccid condition of the intestine below will each serve as valuable guides to the seat of trouble. Not only should the constriction be relieved, but the constricting bands should be entirely removed. Thus, if the appendix is the seat of trouble, its ligation and complete removal are indicated.

It is a matter of prime importance after relief of the strangulation to evacuate the distended and paralyzed bowel. This may be accomplished by means of one or more incisions, which can be closed readily by means of the Lembert suture. When the obstruction is due to the

matting together of a number of intestinal coils, unless the adhesions can be readily broken up the safety of the patient will be consulted best by performing either an intestinal anastomosis between the healthy bowel leading to the adherent coils and that leading from them, or by forming an artificial anus. Constant peristaltic and respiratory intra-abdominal motion may ultimately cause the complete disappearance of extensive intestinal or omental adhesions.

In cases of strangulation alimentation should be administered by the rectum, and stimulants used freely either by the rectum or subcutaneously. The stomach should be washed out thoroughly, this treatment being repeated in proportion to the severity of the vomiting. Absolutely nothing should be given by the mouth. After the cause of the constriction has been removed a saline purge acts as a valuable aid in restoring tone to the paretic bowel.

Volvulus.

Twisting of the bowel is the cause of intestinal obstruction in about 3 per cent. of all cases. The twist is usually about the mesentery as an axis. This form of intestinal obstruction occurs most commonly in men past middle life who have long suffered from constipation. The sigmoid flexure is most frequently affected. Even in the form characterized by the intertwining of several loops it is with the sigmoid flexure that the small bowel usually becomes entangled.

A long mesentery with a comparatively narrow attachment is necessary for the development of the twist. This may be congenital; more commonly it is acquired, years of constipation so dragging upon the sigmoid flexure that it is greatly elongated, the two extremities being constantly more approximated until the condition suitable to the development of the trouble obtains.

Venous congestion plays an important part in the changes dependent upon volvulus. The involved loop becomes engorged with blood and immensely distended from decomposition of its contents. Peritonitis is very frequently developed. The constricted portion of the bowel becomes gangrenous. As in other forms of intestinal obstruction, obstinate constipation, vomiting, and abdominal distension are present. The disease has no distinctly diagnostic features, but should be suspected when in a man at or past middle age, of constipated habit, severe but not agonizing pain, attended with symptoms of moderate shock, inaugurate an illness characterized by moderate bilious vomiting, absolute constipation, and great abdominal distension, with tenderness appearing shortly. Tenesmus and a history of distension, first appearing in the region of the colon, would still further strengthen the diagnosis.

The treatment for obstruction from volvulus is purely surgical.

Purgatives are as evil in their effects as in other forms of obstruction, and their administration has often been the starting-point for the onset of acute general peritonitis. A gradual forced injection of water with the patient in the knee-elbow position may possibly accomplish reduction before the bowel is fixed in its abnormal position by distension, congestion, and peritonitis.

If the diagnosis is fully established, no time should be lost in opening the belly, untwisting the bowel segment, and evacuating its contents.

Enterotomy may be necessitated by gangrene and by the impossibility of retaining the bowel in a normal position.

Lavage of the stomach, the avoidance of food by the mouth, and in general the treatment applicable to other forms of obstruction are valuable in cases of volvulus.

Obstruction from Foreign Bodies.

Under this heading are considered not only those cases of obstruction due to foreign bodies which when swallowed lodge in some portion of the alimentary canal and mechanically block the onward passage of its contents, but also those cases in which acute symptoms are produced by intestinal concretions, enteroliths, gall-stones, hydatids, or any mass sufficiently large to block the bowel.

A foreign body which has passed into the stomach, if of large size, will probably be arrested in that viscus. Should it pass the pylorus, it will probably lodge in the cæcum. If the cæcum is safely passed, its final evacuation is not yet assured, since the rectum is also a favorite lodging-place for these bodies.

Large numbers of small bodies may be swallowed which individually can readily pass through the bowel, but which taken in great quantity may form a conglomeration sufficiently large to produce occlusion. Cherry-stones frequently act in this way, and cases are on record where concentric masses of hair filling the stomach and small intestines have caused death from obstruction.

In the majority of cases the œsophagus is an accurate gauge as to the possibility of a body passing the entire length of the alimentary canal, the chances being largely in favor of spontaneous discharge of whatever has passed into the stomach through the cardiac valve. Bonet states that Charles II. of England placed a razor and two knives in the mouth of a professional sword-swallower; they were swallowed, and discharged *per anum* upon the third day.

The diagnosis of obstruction from foreign bodies will usually depend upon the history of the case. If the symptoms are caused by the lodgment of a gall-stone in the bowel, there can commonly be elicited a previous record of sharp colicky pain, of partial obstruction, of vomit-

ing, and of some local peritonitis about the region of the liver. In obstruction by foreign bodies the distension is slight; the amount of systemic shock is far less, and the duration of the attack is somewhat longer, than usually obtains in other forms of obstruction. The symptoms frequently denote only partial blocking, the vomiting being moderate in amount and not stercoraceous, and the constipation not being absolute. Except in the case of enteroliths and very large foreign bodies a tumor can rarely be felt.

When obstruction is fully developed and the diagnosis of a foreign body in the causative rôle fairly established, an abdominal section with removal of the foreign body are indicated. If the lodgment is in the rectum, the body should of course be removed through the anus. If operation is absolutely refused, the controlling of pain and violent peristalsis by morphine hypodermically, deep-forced enemata, gentle massage, and feeding by the rectum may be tried. After acute obstructive symptoms have passed off, a continued gentle action upon the bowel, such as is produced by a pill composed of aloin, strychnine, and belladonna, is indicated.

Intestinal Paralysis.

Intestinal obstruction may develop suddenly, and may run to a fatal issue, yet at the autopsy there may be no sufficient cause found for the symptoms observed during life. In some of these cases the muscular coat of the bowel is found intact. The symptoms may depend upon reflex action or upon a general condition of the nervous system; thus severe injury to the testicle, operations about the rectum, or general hysteria have all been accompanied by symptoms of acute intestinal obstruction. These symptoms are usually of an evanescent character, and are promptly relieved by attention to the condition which excited the reflex.

After abdominal wounds, however, tedious laparotomies, or severe contusions in the abdominal region, there may be developed a condition of intestinal paralysis which quickly leads to obstruction, to great distension, and to death from either septic absorption, exhaustion, or peritonitis.

Inflammation or ulceration of the mucous membrane sometimes causes cessation of peristalsis and resultant obstructive symptoms. Denarié gives the history of a case perishing after nearly two weeks of obstinate constipation. There was great meteorism and systemic depression, but no pain or fever. At the autopsy a rodent ulcer of the descending colon was found; beyond this nothing pathological was observed in connection with the intestinal canal, excepting great distension. It is probable that in the great majority of these cases of paralysis the symptoms are dependent upon extension of irri-

tation or inflammation from the mucous or peritoneal coats of the bowel to the muscular layer.

Fatty degeneration of the muscular coat of the bowel may act as a direct cause of intestinal obstruction and death. In one case examined by Jordan the microscope confirmed the fatty change which the muscular fibres were supposed to have undergone. The patients who exhibit this degeneration are those who suffer from fatty changes in other parts of the body. The ultimate paralysis is commonly produced by flatulent distension, but any injury or operation about the peritoneal cavity or pelvis may determine the incompetency of the already weakened muscular fibres. It is universally recognized that in very fat patients symptoms of intestinal obstruction are peculiarly prone to occur after abdominal section.

A purely neurotic paralytic obstruction—such, for instance, as is dependent upon hysteria—would be marked by irregularity in course and the characteristic manifestations of disordered nerve-action. When observed it has been in the persons of hysterical females. The reflex paralysis has also been characterized by short duration and sudden disappearance of symptoms.

The paralysis dependent upon abdominal injury or visceral exposure is that most commonly encountered, since it is this form which occurs after operation. Following abdominal section, the course of the patient may seem satisfactory for from one to three days, when a condition of partial collapse sets in. Unless the patient is very closely watched the onset seems sudden. The pulse is rapid and running, the belly quickly becomes greatly distended, there is vomiting of ingested food or bilious matter, and there is absolute constipation. Pain, though severe at times, does not reach the agonizing intensity characteristic of strangulation. There is no marked tenderness and no characteristic alteration in the temperature. Death seems to occur from heart failure.

Paralytic obstruction dependent upon degenerative changes in the muscular layer of the bowels is usually observed in patients who are advanced in years, and who show atheromatous or fatty change in other parts of the body. There is a preceding history of long constipation, and possibly of occasional attacks of temporary obstruction. The acute onset is usually preceded by obstinate constipation, symptoms of obstruction developing after the taking of an active purge. The symptoms are the same as those characteristic of intestinal paralysis from other causes.

It is particularly in cases of intestinal paralysis that salines have won their reputation. Administered in the first stage, before paralysis has fairly developed, they seem to have the power of re-establishing peristalsis, of restoring tone to the muscular coat of the bowel, and of sweep-

ing from the intestinal tracts the partially-digested matter ripe for fermentation and putrefaction. That the paralysis dependent upon a beginning typhlitis, salpingitis, or any form of local peritonitis has been many times avoided by the prompt administration of saline cathartics cannot for a moment be doubted. Salines, then, should be administered freely in the beginning of this form of obstruction.

If the distension has reached any great development and vomiting has set in, salines are no longer indicted. Absolutely nothing should be given by the mouth; lavage of the stomach should be practised; the rectal tube should be inserted to excite peristalsis and draw off wind from the rectum; the patient should be freely stimulated by whiskey *per rectum* or hypodermically; and the faradic current should be applied with one metal pole within the anus, the other being placed over the motor points of the abdominal muscles. If the distension still increases, multiple punctures into the inflated intestinal loops may be made with an aspirator or hypodermic needle. Finally, if death threatens from septic absorption or over-distension, the abdomen should be opened, the bowel should be incised in as many places as evacuation of its gaseous and liquid contents require, and an artificial anus formed. Should the patient recover from the acute attack, this opening will close spontaneously. The over-distenson being relieved, there is a chance that the tonus of the muscles may be restored. For spontaneous resolution when the meteorism reaches an extreme limit there is not the slightest hope.

Where there is acute pain morphine administered hypodermically is of great service. Strychnine, pushed to its extreme physiological limit, may prove a valuable adjuvant in restoring tone to the paralyzed gut. Stimulating enemata, such as turpentine or asafœtida, have at times seemed to accomplish good. Belladonna in full doses is also said to be effective. Other drugs are absolutely useless.

Chronic Obstruction.

This form of obstruction is produced by any cause which occasions a gradual narrowing of the lumen of the bowel. Thus the shrinking of plastic lymph deposited upon the bowel-surface during acute inflammation, cicatricial contraction following ulceration or extrusion by sloughing of an intussusceptum, the gradual blocking caused by matting together of coils of the bowel, or the encroachment upon the lumen of the bowel by new growths, produce the symptoms of chronic obstruction. The bowel above the point of narrowing is commonly dilated and ulcerated. The amount of narrowing is not necessarily indicated by the severity of the symptoms, since frequently death occurs with an opening so large that it is difficult to imagine why the obstruction could not have been relieved.

Chronic obstruction is usually indicated by irregular attacks of colicky pain, noticed a few hours after eating and increasing in frequency. There is frequently vomiting. This is rarely copious, but may become fæcal upon the supervention of an acute attack. Meteorism is not very well marked. Peristalsis can frequently be seen plainly through the abdominal wall. If a new growth causes the narrowing, in addition to the foregoing signs a tumor may be detected.

By careful dietetics and attention to producing regular alvine evacuation, preferably by enemata, operative treatment may be indefinitely postponed. A pill of aloin, strychnine, and belladonna is especially serviceable in promoting peristalsis and preventing accumulation of fæces. This, together with the deep enemata and gentle massage of the belly, is especially the treatment for cases due to fæcal impaction.

When symptoms are progressive, operative interference must be advised, particularly before the onset of an acute attack. The patient is then is a fairly good condition, the surgeon is fully prepared, and a formal and complete operation can be performed with a prospect of success.

If the narrowing is caused by a cancer, the latter should be removed if possible, and the continuity of the gut be restored by lateral anastomosis. If the malignant growth cannot be removed, it should be either switched out of the direct alimentary tract by means of a lateral anastomosis of the bowel above and below the seat of trouble, or, as the most conservative operation in so far as life is concerned, an artificial anus should be formed.

If the narrowing is non-malignant, unless it can be remedied by direct interference it should be excluded by lateral anastomosis. The mortality dependent upon resection is so great that this operation is scarcely justifiable when there is an alternative.

Certainly in the vast majority of cases of acute intestinal obstruction it is absolutely impossible to determine the exact mechanical cause which is exciting symptoms. These are very much alike, from whatever cause the obstruction arises. In the preceding pages there has been given a brief review of the salient features of the various forms of obstruction and of the special treatment applicable to each form. It seems fitting that there should be a general review of the various methods of treatment proposed for the cure of this class of cases.

Diet and Medication.—Neither food nor drink should be given by the mouth during the continuance of acute obstructive symptoms. This is not merely because there can be no digestion and no absorption, but because by taking alimentation into the stomach fresh matter is supplied for decomposition and fresh impetus is given to the exhausting vomiting. In one case of acute obstruction I withheld

food for six days. The patient recovered, showing no marked emaciation as the result of her long fast.

Beef peptonoids, peptonized milk and eggs, and stimulants should be administered by the rectum. The thirst may be relieved by gently injecting one or two pints of warm water into the lower bowel. If the heart shows signs of flagging, especially if collapse threatens, by means of a fountain syringe and a fine canula 3 to 6 ounces of whiskey, dissolved in 1 or 2 pints of warm sterile saline solution, may be thrown by gravity into the loose cellular tissue of the loins or the buttocks. By gentle friction over the seat of injection rapid absorption is obtained. Hypodermic injections of ether, frequently repeated, are peculiarly applicable to this condition. Digitalis does not give satisfactory results. Against heart failure whiskey is the main stay, and must be pushed until its physiological effect is produced. The rectum may also be used for the absorption of whiskey, but in this case the drug should be diluted with at least six times its bulk of water, since acute inflammation of the mucous membrane has been produced by concentrated solution.

Opium and belladonna are indicated when pain becomes so intense and vomiting so frequently repeated that the patient's strength is rapidly exhausted. They should be given together, and preferably in the form of alkaloids by hypodermic injection.

Strychnine is of service in conditions of profound nervous shock and in paretic states of the bowel. To be of service it must be pushed till its physiological effect is produced.

Purgatives are to be avoided.

Intestinal antiseptics, such as salicylate of bismuth, β-naphthol, salol, and boric acid, may be employed if they do not increase the vomiting. They are particularly serviceable when given in the course of lavage.

Lavage of the Stomach.—This treatment, originally advocated by Kussmaul, has received the highest clinical indorsement. Its effect is direct and readily understood. It mechanically removes a large quantity of putrid septic matter which otherwise would be slowly and laboriously regurgitated by violent muscular efforts, thus still further weakening an already debilitated patient. It assists Nature in her eliminative efforts, and almost without exception produces an immediate improvement in the patient's condition. Indeed, there is so great an amelioration of symptoms that this procedure is utterly condemned by some surgeons as producing, like opium, a seeming improvement not warranted by the condition of the bowel at the seat of obstruction, and thus leading to a postponement of operation.

In some cases it produces not only relief, but is absolutely curative; Mahnert reports several cases of cure. Even where death is inevitable it is productive of such relief that it may be employed if nausea

and vomiting are well marked. Curschmann ranks washing of the stomach next to opium as a palliative and curative agent. Nothnägel and Gerster commend this procedure, as do indeed all surgeons who have fairly tried it.

Either plain water may be used or normal saline solutions or mild antiseptic lotions. Since there is a patulous condition of the pylorus, the weak antiseptic solutions are particularly indicated, as by becoming mingled with the intestinal contents further fermentation is retarded or entirely prevented. These injections should always be made with hot solutions (106° F.), and should be repeated in accordance with the severity of the vomiting and the character of the eructated material.

Enemata.—In the use of enemata there is more confidence than in all the other palliative means of treatment combined. Though especially applicable to intussusception, paralysis may be benefited by the stimulus thus given to peristalsis. In chronic obstruction dependent upon impacted fæces or upon narrowing in some portion of the colon the use of enemata is practically the only palliative measure which gives any hope of success.

In making these injections certain points of cardinal importance must be regarded. When the injection is given for the purpose of exciting peristalsis, as in the case of intestinal paralysis or fæcal impaction, it should be administered as rapidly as possible, and should be either cold or very hot. Its beneficial effects will be favorably modified by the addition of turpentine, asafœtida, or other stimulating medication.

When the injection is given for the purpose of mechanically overcoming obstruction, as in the case of intussusception, the liquid should enter the bowel by a gradual, steady flow. The temperature of the injected liquid should not differ greatly from that of the body. The pressure should be uniform and long continued, starting at two pounds (elevation of the reservoir four feet), and if necessary gradually increasing to eight pounds (elevation of the reservoir sixteen feet). At the most not more than three-quarters of an hour should be spent in attempting to force the liquid past the seat of obstruction.

The danger of rupturing the bowel must be borne in mind. In every case where beginning mortification is feared—that is, where the symptoms have been very acute and have lasted for upward of three days—the danger of forced injection is so great and its probable efficacy so slight that this procedure should give place to operation. Under any circumstances there is some risk in the employment of eight pounds of pressure, though this is far within the bursting strain of normal gut.

In view of the many successful results following even imperfect attempts at this method, this risk is justifiable in suitable cases, provided preparations are made for immediate abdominal section should

symptoms characteristic of rupture of the bowel appear. The first attempt at reduction by injection should be so thorough that the physician can feel assured that the particular case of obstruction under treatment is not amenable to this method of reduction. At the first effort the circumstances are all more favorable for cure than at any subsequent time, and more force and perseverance are justified. There are many recorded cases showing that second and third attempts at reduction have succeeded when the first failed; this, however, was undoubtedly due to the greater thoroughness with which the latter efforts were made. These forced enemata should always be made by means of the fountain syringe: it is impossible to gauge the amount of pressure exerted by the Davidson or other pumping syringe. I know of three cases where injections administered by the Davidson syringe resulted in rupture of the bowel and speedy death.

Electricity.—In paralytic distension and obstruction the use of electricity has been followed by brilliant results. Thus, Auffret records a case which entered the hospital with great abdominal pain, tenderness, meteorism, and bilious vomiting. Abdominal facies was marked, the thighs were flexed upon the body, the pain was located about the umbilicus, the dilated intestinal loops were clearly outlined through the parietes. The pulse was scarcely perceptible, the temperature was subnormal. The following day all the symptoms were exaggerated and death seemed inevitable. The poles of a faradic battery were placed, one over the abdominal parietes, the other within the rectum; the application was continued twenty minutes, and was carried to its maximum intensity, when the patient experienced a sudden jar, accompanied by a feeling of intestinal displacement. Immediately there was a free evacuation of gas and fæcal matter. The patient rapidly convalesced.

When it is uncertain whether obstruction is caused by paralysis or by mechanical blocking, the application of electricity by means of the faradic battery should be given one thorough trial, preferably by means of a metal electrode carried into the rectum, the sponge electrode being applied to the belly-wall. As a means of applying the current still more directly Heard advocates filling the rectum with saline solution and introducing the metal electrode into this.

It certainly cannot be claimed that even the majority of cases of paralytic obstruction will yield to electric treatment. That some do is indisputable. Since this agent can do no harm, and since little time is consumed in its application, and in some cases its results are curative, it should be given a fair trial in suitable cases.

Gaseous Injections.—The injection of air or gas as a means of locating and of overcoming intestinal obstruction has lately been warmly and nearly universally commended. The indications for the

use of air-insufflation are practically the same as for the employment of aqueous injections. It cannot, of course, be denied that gas diffuses more readily than water, and hence that it may pass an obstruction that would effectually bar the ingress of the latter. The pressure, however, is not so readily regulated, and, as in certain cases the weight of the water seems to be an important factor in the accomplishment of the cure, insufflation is not so valuable a method of treatment as injection of liquids. The cause of frequent failure in the use of insufflation, as in the employment of liquids, is dependent upon an imperfect method of applying this treatment. Any injection into the bowel causes a spasmodic resistance and effort at extrusion. This is increased if the pressure is constantly varying. Spasm ultimately yields to steady, continued pressure, even though this be slight. If obstruction is to be overcome, the gas must reach the seat of trouble, and it is far safer to accomplish this by moderate continued pressure, continued for thirty or forty minutes, than by rapidly increasing the pressure if in five or ten minutes no results seem to follow.

Reported cases of rupture which have occurred during insufflation show that this method of treatment is not without danger. A manometer should always be attached to the injection-pipe for the purpose of accurately gauging the amount of pressure employed.

Metallic Mercury.—The use of metallic mercury as a means of overcoming obstruction is rare at the present day. Yet this treatment is warmly advocated by Matignon, who states that when employed in cases of ileus following fæcal accumulation the metal becomes finely divided, and so coats and penetrates the obstructing mass that the latter is loosened and its discharge is facilitated. Matignon states that in no instance is mercurial poisoning produced; that pain and vomiting are quickly relieved; and that frequently, after all other means have proved absolutely fruitless, a prompt evacuation of the bowel contents follows this treatment. Mercury has also been employed as a rectal injection, in the hope that by its weight invagination might be reduced. Heard injected one pound into the rectum of an infant aged five months, and then inverted the child, hoping by this means to cure an intussusception.

The special applicability of mercury would seem to be in cases of fæcal impaction where other means of treatment have not been successful.

The Rectal Tube.—In the beginning of paralytic distension the rectal tube is of distinct value. It excites peristalsis, and by overcoming the resistance of the sphincters relieves tension by allowing large quantities of gas to escape. The sharp angularities of the sigmoid flexure and its free mesenteric attachment prevent the point of the tube from passing beyond this portion of the gut; hence there is

nothing gained by passing the tube deeper than five or six inches. The attempt to reduce an invagination or volvulus by a stiff tube is not to be commended.

Injections of Ether.—Ether has sometimes been injected into the bowel as a means of encouraging peristalsis, and in cases of invagination as a means of dilating the lower bowel by its vaporization and thus effecting reduction. Clause reports two successful cases in which relief was immediate upon the injection of a pint of a 3 per cent. solution of ether. This treatment is, however, followed by a local inflammation so violent that it at times excites a pathological condition as dangerous as that for the cure of which it is advised.

Position.—In medical literature there are a number of cases recorded in which marked symptoms of obstruction were immediately overcome by either inversion of the patient or inversion combined with shaking. The knee-elbow position persisted in for some time has at times relieved symptoms.

Abdominal Massage.—Hutchinson highly commends kneading of the abdomen under an anæsthetic and in combination with injections as a treatment for nearly all forms of intestinal obstruction.

In the obscurity which always surrounds cases of obstruction the judicious application of massage is purely a matter of chance. Not only may it be hurtful in cases of peritonitis, but it may immediately determine the rupture of a greatly distended and congested loop of gut. It is easy to see how massage may be beneficial in every form of acute obstruction, but to apply this method so that it will necessarily produce the result desired is an impossibility.

When intussusception is seen early, the effect of injections may be materially aided by massage, and in cases of fæcal impaction uncomplicated by peritonitis this method of treatment has given good results.

The application of ice to the abdomen and the administration of leaden bullets by the mouth, both treatments which have been warmly advocated, are mentioned only to be condemned.

Puncture of the Abdomen.—In cases of meteorism sufficiently developed to embarrass the respiratory function, Ogle advocates one or more punctures into the distended gut by means of an aspirator or hypodermic needle, and the withdrawal of as much gas as possible. These punctures should be made in the most distended part of the abdomen. After all the gas that can be drawn out is evacuated, a few drops of carbolic solution or iodoform oil should be injected through the needle to disinfect the punctured tract.

In excessive and dangerous tympany punctures may be of distinct service. They should be made by means of a fine needle and under most careful antiseptic precautions. The needle should be driven in with a sudden violent thrust, the thumb guarding against too deep

penetration. This lessens the danger of the bowel being pushed before the point of the instrument, rather than being penetrated by it. A wire should be provided for cleaning the canal of the needle in case this becomes blocked. As many punctures should be made as are necessary for the entire relief of pressure symptoms. If the muscular coat of the bowel retains the slightest amount of tonicity, the puncture will be immediately closed, since as the gut contracts the relative change in the opening through the various coats at once occludes the minute canal. If the gut is in a condition of absolute and hopeless paralysis, fæces may leak through even the minute opening made by a hypodermic needle. The condition in these cases, however, is so desperate that it is a question whether any means offers the slightest hope.

Enterostomy and Colostomy.—By these terms is meant the establishment of an artificial anus in the small and in the large intestine respectively. The operation, when it concerns the small intestine, consists in making an incision in the right iliac region and securing the first distended intestinal coil which presents to the entire circumference of the peritoneum about the parietal wound, the peritoneal and skin surfaces of which have been united by a continuous suture. The gut is then incised and its contents evacuated. This operation is one which may be indicated when the surgeon is not called to see a case of obstruction until the patient's general condition is so bad that formal operation is contraindicated. In these cases it has often succeeded in saving life. The relief afforded by the artificial opening frequently allows Nature to overcome the obstructions in the intestinal canal. If this occurs, the fæcal fistula will close spontaneously or may be closed by plastic operation.

Colostomy, or an artificial anus opening into the colon, will be indicated in inoperable cases of acute obstruction located in the colon. It is rarely performed except for the relief of chronic obstruction, such as that which occurs in cases of cancer of the rectum. As far as statistical study goes, the lumbar operation is to be preferred, though for convenience to the patient an inguinal operation is much better.

Abdominal Section.—By this term is implied a formal opening of the abdominal cavity for the purpose of discovering the seat and nature of the obstruction, and of restoring the continuity of the alimentary canal. Where gangrene or other local condition necessitates resection of the gut, lateral approximation gives far greater promise of success than either end-to-end suture or invagination.

In all cases of acute obstruction abdominal section should be immediately resorted to after one thorough attempt at restoring the continuity of the intestinal tract. The mortality from this operation as gathered from statistics is exceedingly discouraging. This is entirely

because operation is too long postponed. Perhaps in the majority of cases the surgeon is not called in until the patient is actually dying. During and after operation heat preservation and combating of shock are most important indications. The operation should be performed as quickly as possible. Not more than half an hour should elapse between the opening and the closing of the belly. Where more time than this is required, it will usually be better to form an artificial anus, rather than to attempt to restore the continuity of the gut. Of course strangulation must be relieved, and the distended and paralyzed gut must be emptied of its contents. At the completion of the operation shock will be relieved and a natural position of the intestines will be favored by copious flushing out of the peritoneal cavity by 0.7 per cent. sterile saline solution at a temperature of 106°.

The whole treatment of acute intestinal obstruction may be briefly summarized by stating that in invagination and in intestinal paralysis only should operation be delayed. In invagination the delay should not be longer than the time required to note the effect of one deep-forced injection. This is a matter of a few hours at most. Internal paralysis should be treated in accordance with its cause. In general, the knife and hot saline flushing should be held as the last resort.

In obstruction due to strangulation, volvulus, congenital malformation, or foreign body the first thought should be operation, nor should any other method of treatment be considered for a moment.

PERITONITIS, APPENDICITIS, AND PERI-TYPHLITIC ABSCESS.

By ROSWELL PARK, A. M., M. D.

PERITONITIS.

General Considerations.

Peritonitis as a disease has had an identity of its own only since the beginning of the present century. Previous to that time it had no independent recognition, and while the gravity of the condition had not been overlooked, its most prominent symptoms had been regarded either as accidental or secondary.

The disease may be regarded from the anatomical, the clinical, and the pathological point of view, and according to each of these it is possible to group cases in such a way as to classify them. Taking first the clinical classification, we may make the following divisions: 1. Idiopathic; 2. Consecutive; 3. Perforative; 4. Traumatic; 5. Chronic; 6. Tubercular; 7. Malignant; 8. Latent; 9. Intra-uterine and infantile.

Idiopathic Peritonitis.—While it is a question whether a complete inflammatory disturbance can ever occur without the presence of micro-organisms, still there are apparently certain forms of peritonitis in which these do not figure. The so-called "idiopathic" form is frequent in the course of chronic Bright's disease and of scurvy. In both of these conditions there is undoubtedly a toxæmia, but its exact relationship to the peritoneal inflammation is unknown. The same is true of acute rheumatism, and an acute rheumatic peritonitis is possible, though very rare. Why, in the course of this disease, the peritoneum and pleura should suffer so seldom and other serous membranes so often we do not know. Malaria also may cause acute peritonitis, and many cases of this disease in patients suffering from chronic malarial poisoning will not yield without the administration of quinine. A so-called menstrual form of acute peritonitis is also described in which probably exposure to cold plays a part.

The Consecutive Form of Peritonitis is due to an extension of inflammation from surrounding parts, and most frequently from the abdominal viscera. It appears, furthermore, that this occurs more

often from the hollow than from the solid viscera. It is, for example, much more common as an extension from the stomach, intestines, gall-bladder, uterus, or Fallopian tubes than from the spleen, liver, kidneys, pancreas, or mesenteric lymph-nodes. It is consecutive to parietal inflammations, as from erysipelas, carbuncle, or burn of the abdominal wall. It also succeeds inflammation of the thoracic viscera, as pleurisy, pericarditis, pulmonary abscess, empyæma, hydatid cyst, or even phrenitis. It follows infectious embolism of branches of the abdominal aorta, and phlebitis and periphlebitis of the abdominal or pelvic veins. It comes after urinary infiltration from any cause; but perhaps the most common instances of consecutive peritonitis are met with after strangulation of the intestine or acute obstruction from any cause, and from the results of the puerperal condition. So far as the former are concerned, a small strangulated hernia, an invagination of the bowel, a fæcal impaction producing obstruction, are equally favoring anatomical conditions. In any one of these instances the process consists of stasis, exudation, and infection. Of the condition of metro-peritonitis it must be said that it is perhaps more common even after abortion or miscarriage than after delivery at term. This form is treated of at length in works on gynæcology and obstetrics, and needs no further attention here.

The Perforative Form.—That peritonitis invariably ensues after escape into the peritoneal cavity of any secretory or excretory material which Nature has intended to keep out of it is well known. Such attacks are for the most part fatal, although in rare instances the inflammation is circumscribed and recovery may ensue. Perforation may occur from the stomach, as in cases of gastric ulcer, and these are the cases in which the inflammation is most likely to be localized. It may occur from the intestine. The majority of these cases are post-typhoidal, when the disease assumes a fulminating type and patients die very rapidly. It may be the result of post-dysenteric lesions, when there has been a diphtheritic form of enteritis, in which there is always a possibility of sloughing of a portion of the intestinal wall. It may be a result of gangrene of the intestine, due to strangulation, a sloughing portion giving way and permitting fæcal extravasation. When a hydatid cyst ruptures into the peritoneal cavity, it nearly always causes acute peritonitis, its contents being apparently toxic. Perforative peritonitis may also result from rupture of an ureter, perhaps due to the presence of a calculus, or to rupture of the bladder or gall-bladder, or of any abscess—for example, perityphlitic—in the neighborhood of this membrane.

The onset of cases due to perforation is very acute, and is followed usually by sudden meteorism, with profound collapse and speedy death.

The Traumatic Form.—This comprises all cases of peritonitis due

primarily to trauma, whether the peritoneum has been opened or not. Thus, violent contusions upon the abdomen not infrequently provoke it, and crushing injuries which produce rupture of the liver or the bladder or of the kidneys are frequently followed by it. The most common injuries which produce it are penetrating wounds—lacerated, punctured, and gunshot. This form of disease is nearly always septic and sometimes putrid. In one sense it might also be proper to regard cases which are due to strangulation of the bowel as traumatic, since the actual condition is not widely different.

Chronic Peritonitis.—This form is perhaps more often due to a condition of chronic Bright's disease than to any other one factor. It is characterized anatomically by a much-thickened and opaque peritoneum, within which more or less adhesion of contents has occurred. The amount and the extent of these adhesions in some instances is wonderful. Cases are on record in which all the viscera were so knitted as to be inseparable (*peritonitis obliterans seu deformans*). This clinical form of the disease is characterized by the absence of acute manifestations and the tendency to fibrinous exudate, which often forms adventitious membranes, which latter constitute superimposed layers and cause the peritoneum to appear much thicker than it really is. This is especially the case about the liver, and it is worth while to remember that in cases of perihepatitis the thickened investment of the liver is in some measure due to this cause.

These new membranes may divide the general peritoneal cavity into a few or numerous chambers, so that when the abdomen is opened it appears to be filled with cysts. Inasmuch as fluid may collect in each of these chambers, the resemblance is more striking. Careful dissection and examination will clear up all doubt. It is characteristic of chronic peritonitis that the mesentery is shortened and that the actual length of the intestine is diminished. Sometimes it is reduced by several feet and its diameter is contracted. This is the result of cicatricial and atrophic changes, which bespeak a long duration for the disease.

This form is nearly always accompanied by marasmus, which may be explained by the anatomical condition just alluded to and by more or less ascitic collection of fluid. Sometimes the ascites is very pronounced. On the other hand, the peritonitis itself is sometimes the result of the ascites due to other causes, since the distension of the membrane by fluid seems to lead to chronic inflammatory processes in its texture. The former condition corresponds with the "idiopathic dropsy" of many of the older writers. From what has been said it does not follow that this form is necessarily a chronic process *de novo*. Not infrequently it is the relic of an acute attack.

Tubercular Peritonitis.—Like tubercular disease elsewhere, this may be primary or secondary. The slow forms are characterized by

the condition of the peritoneum described in the preceding variety, plus the peculiar dotted appearances, perhaps even nodular, which tubercular deposits produce. In many of these cases, especially the slowly progressing ones, the omentum will be found to have undergone distinct caseous alteration. The abdominal cavity may contain serum clear or turbid, pus or puruloid material, or recent or old blood, since hæmorrhage from the affected surfaces is not uncommon. Tubercular peritonitis assumes a proliferative type when time is afforded, and is the cause of numerous adhesions. It may be acute—in fact, almost as overwhelming in its onset as tubercular meningitis—or it may run a very slow and irregular course. Its symptoms are vague and obscure. It is characterized, first, by general ill-health, which later becomes pronounced marasmus accompanied by diarrhœa, especially if the intestines be ulcerated. Unless pus or fluid be present the abdominal walls are retracted. Two very valuable signs of this condition are induration and nodulation of the omentum, when it can be felt, and reddening and thickening around the umbilicus, due to extension of the disease along the obliterated umbilical vessels.

Malignant Peritonitis.—Less than half of these cases are really primary, the major portion being secondary or metastatic. A primary miliary carcinosis is known, but is very rare; as a secondary condition it is less so. Circumscribed cancer of the peritoneum is now and then met with, and occasionally the peritoneum is filled up with a mass of colloid material, to which the name of colloid cancer is given; but it is really due to colloid degeneration of medullary carcinoma or small round-celled sarcoma, which are most likely to occur primarily in the omentum. This form is characterized by mildness of symptoms, by a progressively downward course, and sometimes by hæmorrhages which may be the actual cause of death. Recent investigations make it likely that in cases of widespread cancerous disease there is a toxæmic condition engendered, as the result of the cancerous growth, by unknown substances produced by the abnormal tissue-changes.

The So-called Latent Forms of Peritonitis.—Every practitioner of wide experience meets with fatal cases in which pus or other evidences of diffuse or local peritonitis are found, but in which during life such condition had scarcely been suspected. These are perhaps more common after the form of local peritonitis to be spoken of later as appendicitis. This form of latent disease is indeed virtually always characterized by the presence of pus, and is simply evidence of the fact that the disease had not been recognized, the failure of recognition being due sometimes to the profoundness of systemic poisoning, sometimes to the existence of other and apparently more serious disease; and sometimes it is to be explained by the fact that when pus forms very rapidly the exquisite sensibility of the peritoneum is apparently lost. The

latent type of the disease deserves no place in pathological classifications; it is to be regarded purely as a clinical curiosity.

Intra-uterine and Infantile Peritonitis.—That congenital stenosis of the intestine may lead to a fœtal peritonitis has been shown by Virchow and others. It is usually rapidly fatal from the nature of the condition which primarily produced it. An infantile form has also been distinguished which occurs shortly after birth, and is for the most part due to causes arising from the umbilicus, such as inflammation, lymphangitis, and gangrene of the umbilical vessels, or to umbilical hernia. It is most common in connection with similar disease in the mother or the existence of the disease in endemic form. It is for the most part of septic type, possibly even putrid.

Such is a classification of cases of peritonitis based purely upon their clinical form. The *anatomical* classification is very simple: 1. The general or diffuse form, which has already been sufficiently considered; and 2, The circumscribed or localized form. The second variety may merge into the first as congestion is excited and exudate transplanted by means of the respiratory and peristaltic motions to which the abdominal contents are subjected. Perhaps the most common examples of circumscribed peritonitis are met with upon the bowels and about the cæcum. The traumatic form clinically is frequently also represented by the circumscribed form anatomically. A very rare form of the disease is that which is limited to the cavity of the lesser omentum, which for the most part is consecutive to disease of the pancreas. Virchow also has described a peritonitis *chronica mesenterialis et omentalis.*

Localized peritonitis is also frequently due to fæcal accumulation or to the presence of cystic or solid tumors.

The pathological distinction between the various forms of peritonitis is one of great interest. The following classification is modelled after that of Bumm:

1. Aseptic. Usually local, not always. Characterized by hæmorrhagic or fibrinous exudate with strong adhesive tendencies.

2. Infectious. *a.* Staphylococcus and streptococcus forms, the latter being the most rapidly fatal. These are usually post-puerperal. *b.* Colon infection. Due to the Bacillus coli communis. *c.* Septic. Characterized by pus instead of ichor, and by acute onset with chill and pyrexia. *d.* Putrid. Usually the result of perforative forms.

3. Specific, including tubercular, actinomycotic, malignant, and the gonorrhœal, if there really be such specific forms.

Taking this up a little more in detail, it must be said of (1) the aseptic form that it is at least rare; but experiment has shown that it is possible to provoke congestion and exudation, or even hæmorrhage into the peritoneal cavity, which shall be accompanied by certain symp-

toms and shall terminate by resolution or by adhesion between surfaces. The reader who is interested in this aspect of the question is referred to a paper by the writer,[1] being No. 5 of the Mütter Lectures of 1890–91.

2. *a*, *b*, and *c*—the *infectious* forms. It has been shown, experimentally, that pyogenic organisms produce peritonitis, for the most part naturally, when introduced in excessive amount, or when some other substance prepares the soil and assists their penetration into the deeper layers, or especially when some wound of the abdominal wall favors localization of the infection. The streptococcus and staphylococcus cases are hence usually met with after parturition or abortion. On section there is found a thin, purulent, odorless exudate, or if late this may be thick and creamy. Early in the disease this exudate is extremely infectious; it loses its virulence as the disease progresses or in proportion to its slowness.

Peritonitis due to infection from the colon is a variety but recently constituted by investigations by Professors Welch and Councilman of the Johns Hopkins University. From their investigation it appears that under certain conditions not yet completely recognized the common colon bacillus escapes from its ordinary habitat, and is capable of producing intense and even fatal disturbances in the peritoneum. It is found now within the lymph-nodes and the liver, and is thus seen to have migrated widely beyond its normal limits. This form occurs not infrequently after operation, but may be purely idiopathic or consecutive to dysentery, etc.

The *putrid form* occurs most commonly after operation for perforation. It begins without chill, but with fever which gradually runs higher, and is characterized by a putrid, foul-smelling exudate. It is much less infectious than the other forms, and contains a mixture of micro-organisms, many of which are not known to be pathogenic. It is the result in large measure, if not primarily, of putrefactive organisms. Its pyrexia is due chiefly to ptomaïnes which they produce.

3. Of the *specific forms*, the tubercular and malignant have been already sufficiently considered. The actinomycotic is a curiosity which need not detain us here. We hear a great deal of a gonorrhœal form of peritonitis which is due to extension of gonorrhœal infection through the tubes. Strictly speaking, this is probably an impossibility, so far as a pure type of gonorrhœal infection is concerned. I have taken pains in another place to show that most instances of gonorrhœa are mixed infections, and have also called attention to the fact that gonococci by themselves are not pyogenic. Even in inflamed and distended joints, so long as gonococci alone are present there is no pus, this

[1] *The Annals of Surgery*, July, 1891.

being due solely to a contamination with staphylococci or streptococci; and so, without questioning the frequency of peritoneal complications or sequelæ of gonorrhœal disease, we must relegate these cases to the staphylococcus or streptococcus forms, where they really belong. This is hardly the place for an extended discussion of this aspect of the general topic, or we would gladly consider it at much greater length.

Symptoms.

The first symptoms or signs of acute peritonitis are usually one or more chills or rigors, followed by pyrexia, which may reach 104° or 105° F. High temperature is usually preserved throughout the course of the disease, although it occasionally falls before death, and sudden fall is to be regarded as a bad sign. It is also worth noting that the body temperature sometimes rises for a few hours after death. Almost from the outset the patients display an anxiety of countenance significant of serious disease, and sometimes a condition of prostration and shock is present almost from the beginning, which may amount at any time to collapse. The most characteristic feature of this disease is the abdominal pain or distress which is complained of, and usually described as cutting or lancinating, which is always aggravated by change of position or by such involuntary actions as coughing, and also by any excess of peristaltic action. The abdominal walls become rigid, at least at first, and the semilunar and transverse lines very prominent. The legs are usually drawn up, in which position slightly more comfort is afforded to the patient. Along with pain goes exquisite sensitiveness to pressure, which often prevents the application of such local measures as might otherwise give some relief. The breathing becomes much more rapid than normal, and of the thoracic type. Sudden suspension of pain is generally regarded either as a sign of impending death or of the presence of pus, which amounts to nearly the same thing, sensibility being obtunded as pus forms. After a short time abdominal rigidity gives way to abdominal paresis, and this is followed by characteristic meteorism and tympany, which are more likely to occur if in a given patient the abdominal muscles are habitually relaxed. Along with this condition the diaphragm is pressed upward and the thoracic viscera displaced.

Almost from the beginning there are frequent, perhaps nearly constant, nausea and vomiting, the stomach rejecting anything which may be put into it, and sometimes returning the contents of the intestine by retrostalsis. This sign, commonly so pathognomonic, is occasionally absent or insignificant. In a majority of instances the bowels are costive and peculiarly sluggish. Occasionally—and this most frequently in the puerperal form—there is diarrhœa. Micturition is difficult, because it causes pain, especially when the pelvic peritoneum

is involved. Hiccough is occasionally noted, and is commonly regarded as a bad sign, since it usually precedes death by only a short interval. Throughout the course of the disease the tongue is furred, sordes collect on the teeth, there is a hot and dry skin, and the patient complains, next to pain and nausea, of tormenting thirst. Friction between roughened peritoneal surfaces may sometimes be detected with the stethoscope or by the hand laid upon the abdomen. If fluid forms in large amount, signs of its presence may succeed to those of meteorism, and it is rarely possible to get fluctuation or succussion on account of the meteorism.

In extreme cases, and shortly before death, to the foregoing signs are added sometimes more or less delirium, merging into coma with cyanosis, due to embarrassment of circulation and respiration. Retention of urine, with paralysis of the rectal sphincter, is usually also to be noted. The most frequent complications of peritonitis, which is not itself consecutive, are pleuritis, pericarditis, and jaundice.

The *diagnosis* of acute, general, or even local peritonitis is not difficult. We may have to distinguish it possibly from colic, which we can do by the facts that in the latter the pain is very intermittent, that even when the patient suffers most intensely he is restless, and that pressure and friction give relief. The disease may be simulated in the hysterical condition by exaltation of cutaneous sensibility. In such cases we will observe the presence of other symptoms, as well as the existence of many inconsistencies in the patient's account of the case. There is also likely to be a history of globus or other hysterical manifestations. Rupture of small vessels or aneurisms and embolism of branches of the abdominal aorta, or thrombus of large venous trunks, with phlebitis, etc., occur rarely, and may be at first mistaken for acute peritoneal inflammation. Careful observation extended over a few visits will guard against error and permit a differential diagnosis to be made.

Treatment.

In the writer's estimation the treatment of a given case of peritonitis should depend in large measure upon its characteristics and causation. Following the conventional clinical distinction, without reference to minute pathological distinctions, let us first speak of the so-called idiopathic cases, which are those following, perhaps, exposure to cold, mild abdominal contusion, occurrence of dysentery, and enteritis. For these—as in fact for all—physiological rest of surfaces covered by the peritoneum is above all indicated, and should be secured, so far as the case permits, by the drugs and measures to be mentioned. Such rest is to be obtained, first of all, by entire absence from laxative or purgative treatment, the bowels being opened, perhaps, at the outset by a laxative enema, after which cathartic measures are to be

entirely abstained from. This is a canon in the treatment of such cases which no one can safely violate. If it seems that the case is due to causes arising in the stomach or the intestinal canal, absolutely no food should be given, though possibly pellets of ice may be administered, and if necessary small nutrient enemata, simply for the purpose of affording nourishment and assuaging thirst. Nourishment may also perhaps be administered with suppositories of gluten or some substitute. Local relief will usually be afforded by hot applications and turpentine stupes, unless the abdominal surface be too tender to tolerate their weight. Pain is also sometimes relieved by leeches, though their application will serve only to frighten sensitive patients. The use of ice poultices, as recommended especially by Niemeyer, has not found general favor in this country, and if resorted to at all can only be carried out during the very early stage of the disease.

The sheet-anchor of the physician, in cases such as are alluded to here, must be opium or its derivatives, according to the system first recommended by Graves in 1822, and very generally associated in this country with the name of Alonzo Clark. When resorted to for this purpose and in sufficient amount, opium will be found to furnish sufficient anodyne, tonic, laxative, and generally commendable virtues to make all other medication, for the time at least, unnecessary. The question now is not one of dosage, but one of effect; and it has been found that patients suffering from peritonitis acquire by virtue of their disease a tolerance for this drug which is simply astonishing. It must be given, not in small but in large and frequently-repeated doses, until patients are absolutely free from pain and put comfortably at rest. Under its influence nausea and vomiting will subside, abdominal distension decrease, tenderness be allayed, and fæcal evacuations take place naturally and almost regularly. The amount of opium administered is to be a purely secondary thought. Thirty, fifty, or more grains of opium may be given in a day with salvation to the patient, when perhaps with less the case would have resulted fatally. A girl of thirteen years recently under the care of one of the writer's colleagues took 19 grains of morphine in twenty-four hours, with perfect relief from distressing symptoms, with almost natural evacuations of the bowels, and with satisfactory and speedy recovery; up to the time of her sickness she had never had a grain of an opiate in any form. Nor need one fear from this tremendous dosage the subsequent formation of the opium habit, providing proper care and management be exercised.

While opium, then, is the mainstay in this disease, it will not be amiss if mercurial ointment be applied over the abdominal surface, if intense meteorism be relieved by passage of the rectal tube or by puncture with a fine aspirating needle properly sterilized before use,

nor if in desperate hiccough small doses of cocaine be administered by the stomach, or small amounts of chloroform be inhaled.

Treatment of Septic and Traumatic Cases.—Cases which follow operation, injury, or the puerperal state belong both clinically and pathologically to a different category, and may call for treatment widely different from that already indicated, although in candor one must say that opium has been found sufficient for many of these. In that form of septic peritonitis known commonly as puerperal it has been found advantageous, and sometimes even life-saving, to administer at the outset a large, even an enormous, dose of some laxative or purgative, such as calomel or Epsom salt, by which free purgation, almost to the point of collapse, has been brought about. Explanation of such extremely opposite lines of treatment is to be found in the peculiar capacity of the peritoneum for the absorption of liquids, even when these are essentially septic. Experimental pathology has proved its astonishing capacity in this respect, and not infrequently vigorous catharsis, followed by such physiological rest as opium will then ensure, has met with most pronounced success. Although the name of Lawson Tait is associated with this plan of treatment, it dates back almost to prehistoric times.

Should, however, the sepsis be due to distinct traumatism or to appendicitis, pyosalpinx, suppurating gall-bladder, or other similar disease in or near the abdominal cavity, the case at once becomes one for the surgeon, whose duty it now is to open freely to learn if possible the source of infection, to meet any present indication for drainage, possibly to irrigate the peritoneal cavity either with warm distilled water or Thiersch's solution, to close the abdominal wound, and then drain. The same is true also should this condition supervene after surgical operation. A distinctly different though parallel condition is the putrid peritonitis due to perforation of an abscess, or after typhoid fever or malignant ulceration or perforating wound of the intestine. Here the patient has scarcely one chance in a thousand of recovery unless laparotomy be done, with careful search for the source of infection and removal or repair of the same, and careful removal of products of infection from every part of the abdominal cavity. Considerations of this kind open up the subject of abdominal section for typhoid perforation, which Mikulicz was the first to perform, although without success, for perforative appendicitis, which has been followed by success in the hands of American surgeons; and also for the results of gunshot and stab wounds of the bowels or stomach, with which, again, the names of American surgeons are especially linked.

Laparotomy has been done nineteen times for perforation during typhoid, with four recoveries. (December, 1891.)

Careful consideration of these topics, however, takes one too far

away from the question of general therapeutics, and too deeply into the domain of special surgery, to warrant more than their mention here.

Treatment of Chronic and Tubercular Peritonitis.—Operative treatment of these conditions is based for the most part, we confess, upon empirical grounds. It is well known, for instance, that a condition of abdominal dropsy due to chronic peritonitis, which itself is due to the presence of some tumor or irritating foreign body, has subsided after the performance of abdominal section and the removal of the offending substance. Indeed, ascites without ascertainable cause has been known to subside after laparotomy, the reason for which is unexplained, and advantage has been taken of these inexplicable facts to erect into the dignity of an indication a series of a few accidents, and to formulate rules for laparotomy for the indefinite purpose, yet sometimes successful, of improving or curing these obscure cases.

Tubercular peritonitis especially, it is now well known, can be sometimes combated by the mere performance of a small abdominal section with or without drainage, the operation itself apparently having an alterative effect for which no satisfactory reason has yet been ascribed. Among gynæcologists, however, it has now attained the dignity of special mention and special chapters in their treatises, and we have the statement of more than one of them that all the active manifestations of a tubercular peritonitis, where the diagnosis has been formed by ocular inspection of the peritoneum, have been known to subside temporarily, even apparently permanently, after opening, perhaps with irrigation and drainage, and closure of the abdominal cavity. Here too we must refer the interested reader to the monographs and treatises of the specialists for further information.

APPENDICITIS.

General Considerations.

Under the general term "Appendicitis" are now comprehended the conditions formerly recognized under the names typhlitis, perityphlitis, paratyphlitis, extra-peritoneal abscess of the right iliac fossa, and perhaps certain other terms now more or less obsolete; for all of which the still more recent name *ecphyaditis* has been proposed, the only exception being that the term perityphlitis may still be used as an adjective to indicate the location of an abscess. Researches of the last few years have made it very evident that almost without exception these inflammations begin in the vermiform appendix, from which point they spread to a varying extent and with varying degrees of intensity. In fact, the appendix is now known to be the primary cause of

nearly all cases of general peritonitis except those which originate from the internal genito-urinary tract or which follow operation. It is then of very frequent occurrence, and causes annually many deaths. The recognition of the importance and frequency of this condition we owe, in the first place, to Reginald Fitz of Boston, whose researches, first published in 1886, have been confirmed by Stimson, McBurney, Bull, Keen, and others, all of whom are Americans. The rapidity with which the views of these writers have gained credence on both continents is testimony alike to their own accuracy and the lack of previous appreciation of the subject.

It is now known that the ratio of appendicular inflammation to primary inflammation of the cæcum is about one hundred to one. So far as the relative frequency of this condition and other lesions of the viscera is concerned, the best statistics are those of Tofft, who found residua of appendicitis in 36 per cent. of all of a large number (300) of post-mortem examinations.

Appendicitis does not necessarily imply adhesions. The appendix may be ready to burst, or be even gangrenous, and still be loose in the peritoneal cavity. At other times, although but slightly compromised, it may be so bound down and buried under old exudates and adhesions as to be really lost.

Keen makes five forms of this disease: 1. Mild without abscess, terminating in resolution. 2. Perforative followed by general peritonitis: *a*. A sub-variety of fulminating form, perforating very early. *b*. A sub-variety, mild for some time and then suddenly perforating. 3. Perforative, but protected by adhesions, so that a local abscess results. 4. A class in which abscesses form slowly—*i. e.* chronic—lasting not only for weeks, but perhaps for months. (The writer has seen this form assume tubercular characteristics.) 5. Recurrent, one attack following another, finally fatal after from two to twenty attacks.

But a few years ago Stimson offered the following classification of inflammations about the cæcum: colitis, pericolitis, typhlitis, and perityphlitis. Than this there was at the time nothing better offered, and in the main the conditions thus outlined are still possible, but we have at last learned that perhaps 99 per cent. of cases coming under one or the other of these headings has its origin in an inflammation of the appendix proper. When thus involved the condition of the appendix may be one of intense catarrhal inflammation of its interior, of distension by pus or by fæcal concretions which are very often mistaken for seeds of various fruits, of perforation without much gangrene, or of total gangrene; and all these may be either with or without adhesions. Under either of these conditions also it may be found surrounded or not surrounded by pus, or giving rise to commencing or well-devel-

oped peritonitis. To indicate how rapidly pus may form under this impetus it need only be said that by the fifth day three pints of pus have formed. It has been held by Bull and others that we have a catarrhal form of perityphlitis causing adhesions, although it is hard to understand how a purely catarrhal form of inflammation can spread to and involve serous or areolar tissue. At all events, catarrh of the cæcum, with ulceration due to the presence of impacted fæces or other irritating material, certainly may and does occur, and thus the opening of the appendix may be involved. Again, the interior or mucous surface of the appendix may absorb fluids, and leave within itself solid materials which are irritating and cause relapses. As mentioned above, many so-called seeds, etc. are actually intestinal concretions or simply inspissated fæcal masses. Matterstock found them in 63 out of 146 cases, with real foreign bodies, seeds, etc. in only 9; and Krafft in respectively 36 and 4 out of 106 cases.

Infection of the peritoneum from such conditions as those just spoken of is to be explained by accepting Eppinger's views concerning necrosis epithelialis mycotica; from pressure of fæcal masses, and subsequent infection therefrom, there follow easy invasion of subepithelial tissue and extension through to the peritoneum. Moreover, by a similar and incomplete process we may have stricture of the appendix near its origin and dilatation of its distal end, with retention, by which recurring inflammation is of course favored.

Weir divides the general condition into the following three forms: adhesive, circumscribed, and diffused, according to their anatomical characteristics:

1. Peritonitis appendicularis adhesiva; ulceration likely to occur deep enough to cause adhesions. 2. Peritonitis appendicularis localis; usually with abscess formation. 3. Peritonitis appendicularis universalis; referring to diffuse, septic, or putrid peritonitis, due to perforation.

Concerning the relative frequency of these forms, Weir collected the findings in 100 autopsies, and found diffuse suppuration 57 times, circumscribed abscess 35, in 13 of which the trouble was also diffuse, and extra-peritoneal abscess 4 times.

By some authors children are regarded as especially predisposed, but the majority agree that it is more common in adults, and for the most part in males. Fitz reports, out of 228 cases, 173 below the age of thirty-one, and 207 below the age of forty-one.

The perforative form of appendicitis, especially that leading to diffuse peritonitis, deserves a little consideration by itself. Of this condition Mikulicz makes two forms—one diffuse, septic, from sudden outpour of fæces through a large perforation: patients die before adhesions can form. This belongs to the putrid form of peritonitis already de-

scribed. The second, a progressive fibrino-purulent form, spreading from the immediate neighborhood of the perforation: fibrino-purulent adhesions form by which the general peritoneal cavity is, at least for a time, protected. It leads to foci of encapsulated pus, and in other words to multilocular abscesses. In one such case he opened six pus-cavities through three incisions made at different times as the abscesses seemed to form.

Perforation may occur very early or not till very late; it has been known to happen within twenty-four hours after the onset of symptoms. It is the explanation for nearly all the fatal cases, since Matterstock found perforation 132 times out of 146 fatal cases, and Fenwick 113 times out of 139 cases. Its occurrence is made known by phenomena to be discussed later.

The following brief summary of the *symptomatology* of the disease will have, as seen farther on, a most important bearing on the question of its therapeutics:

The most common first symptom is abdominal pain, varying in severity, which is sometimes referred to the whole abdomen or to the epigastrium or umbilical region, and which perhaps in half the cases is described as having begun in the right iliac fossa. This pain is sometimes preceded by a prodromal stage of vague abdominal discomfort lasting for several days, and is often misleading, because slight, and is therefore often mistaken for a symptom of colic or enteritis. If the pain have been at first diffuse, it begins after a few hours to be limited, and the exact locality of the greatest pain and tenderness is now of the utmost importance. McBurney has rendered us the greatest service in indicating a point, now generally called by his name, situated on a line drawn from the anterior superior spine to the umbilicus, and two inches, or possibly an inch and a half, from the spine. In this disease firm pressure made over this point with the finger-tip will practically always elicit extreme pain and tenderness, although in the last stages tenderness may have disappeared. This sign is of pathognomonic importance, since no other acute disease presents it. While preparing this article the writer has had additional evidence of its value, since by means of it, accompanied by the history of a brief illness, he was able to make a diagnosis of appendix disease in a case of large fibroid tumor filling up the pelvis and causing stricture of the rectum with enormous distension of the abdomen. By operation speedily performed a large amount of pus was evacuated.

Chill and vomiting may or may not occur. The latter usually ceases if the stomach be given absolute rest. Fever is usually present, but varies greatly in degree. Rigidity of muscles, especially on the right side of the abdomen, is of great importance. Tympanites usually occurs during the course of the disease, and may be prominent even by

the end of the first day. It is usually absent when perforation has occurred. A local tumor may or may not be discoverable during the first or second day; it is usually present by the end of the third day. It consists of the inflamed appendix, or cæcum, or omentum, or all three, along with more or less exudate, and perhaps pus. Circumstances may make it difficult to discover, but one is not to waver in diagnosis providing the other signs be present and the tumor absent.

Increasing distension of the abdomen is a bad sign. It will depend in amount largely on the condition of the bowels and the extent of the intestinal paresis. Patients will usually complain when they cough, and sometimes when the right thigh is completely extended. Aside from the distension and the amount of tenderness, the pulse will usually afford a fair index of the gravity of the disease, which is indeed more reliable than subjective pain. In certain cases examination *per rectum* will reveal a tumor or will give some additional positive or negative evidence. Too much reliance should not be placed upon it.

Exaggeration or increasing intensity of pain, accompanied by symptoms of shock and followed by chill, fever, tympanites, and vomiting, indicate that rupture into the peritoneal cavity has in all probability occurred, although similar bad signs in lesser degree have been known to indicate the formation of pus without perforation. If time has permitted the formation of sufficiently strong adhesions, perforation may occur with less perceptible evidence, nothing more perhaps occurring than chill with extension of tumor.

Of course when an abscess ruptures into the bowel there is a cessation of severe symptoms and a subsidence of the tumor.

Fitz says that 26 per cent., and Stimson that 25 per cent., of all cases of appendicitis prove fatal. According to Fitz, of 176 cases of perforative appendicitis, 60 died during the first five days, 56 during the first four days, 28 during the first three days, and 8 during the second day; all of which goes to show that appendicitis may terminate fatally in less than forty-eight hours. It is moreover certain that in the large majority of cases dying within five days the fatal septic or putrid infection begins before the end of the third day.

Recurrent appendicitis was scarcely spoken of previous to five years ago, but Treves has reported a case in which there were fourteen attacks, and McBurney one in which there were twelve attacks within as many months. Krafft learned that 23 per cent. of the 106 cases which he studied had had similar trouble previously. In general it must be said that of those who have suffered once from this disease none are exempt from liability to future similar trouble except those upon whom the operation for the removal of the appendix has been performed.

Treatment.

There is so little to be said in favor of internal medication in these cases that medicinal treatment can be summed up in very few words. First of all, it is necessary to make plain the fact that the use of opiates for the relief of severe pain is perhaps following the dictates of humanity, but is likely to do great harm on account of masking symptoms which are most important and indicative, and by which alone one must decide when to operate. Anodynes, then, should be given only when absolutely necessary. Cold applications, especially with the coil over the right iliac fossa, may do much to check the course of the disease. Laxatives should be avoided, and the stomach should be given absolute rest, especially if it is irritable. Under such gentle and non-compromising treatment as this the mild cases will improve, or at least cease to advance, while the graver and those which shall soon call for operation will show little or no improvement. It is therefore with wisdom and with justice that Keen has epigramatically stated that the "first duty in the case of appendicitis is to call a surgeon." Nothing has been more clearly shown within a few years than that a large proportion of these cases, if they are to be saved, must be turned over very early for surgical relief. In other words, that their therapeusis is essentially surgical, for which reason, before describing the operation, it may be well to stop and consider the

Indications for Early Operation.

These must be carefully watched for from the very outset, since the golden time to operate is before the pathological condition is too far advanced for surgical remedy. Even at the end of the first day operation should be thought of—possibly even performed—if evidences of severe and extending peritonitis develop or if, possibly, signs of perforation should supervene. If in a given case in which appendicitis has been diagnosed or suspected the symptoms are not distinctly improved by the end of the second day, or even after thirty-six hours, it is best to prepare for operation, perhaps even to operate at once. If one wait only for evidence of perforation or even of general infection, disaster will in all probability occur. The acute observer, noting the progress of the case from hour to hour, can usually recognize the signs of impending perforation by a study of the pulse, the temperature, the size of the tumor, the rigidity of abdominal muscles, the development of tympanites, the increase of nausea or vomiting; for which, however, he should not wait. In general, then, it may be said that if tenderness or pressure increase, if the pulse accelerate, the temperature rise, or abdominal distension augment with increase in size or fluctuation of the tumor, operation is to be considered almost inevitable, and should be hastened should there be acute onset of pain. On the other hand, if

nausea disappear in twelve hours, if pulse and temperature subside, and tenderness diminish, the case will probably run a mild course. If these are present at the end of twenty-four hours, the prognosis has thereby improved; but it must be remembered that the majority of the rapidly fatal cases are practically made fatal during the second and third days, and that, so far as perforation is concerned, there are no signs peculiar to this event alone, and that if the case be not improving it is best not to wait. Moreover, there are many undesirable complications incident to too long delay which make the surgeon's work much harder. Distended intestine is restored to place with much greater difficulty, while septic infection, if but begun, is rapidly spread by the manœuvres necessitated during operation.

It will thus be seen, if help is to be afforded in cases in which perforation is imminent or has occurred, that they are among the most urgent to which the surgeon can be called, exceeded in this respect only by impending suffocation or death from hæmorrhage. The wise physician, therefore, is he who calls the surgeon early, and the wise surgeon is he who is always prepared for such an operation.

DIRECTIONS FOR EARLY OPERATION.

These directions are meant to include operation when undertaken under the circumstances just described, at any hour of the night or day and with or without surrounding conveniences. And, first of all, the operation should be made with every aseptic precaution known to the operator, omitting, if possible, everything which may endanger perfect asepsis. If time permit, the skin of the abdominal region should have been covered with a poultice of green soap for the purpose of securing its perfect disinfection.

Since it is difficult—perhaps impossible—to fix on the precise location of the appendix, and inasmuch as there is presumably now no distinct abscess into which we may open at a convenient point, the incision is to be made in the right semilunar line and of sufficient length to permit adequate exploration. As one approaches the peritoneum it is sometimes found that the areolar tissue next to it is œdematous; but this has no known significance. If the peritoneum be found adherent to the tumor or intestine, it must be opened higher up or lower down, and then carefully separated. The small intestines are held upward and toward the opposite side while the operator gently searches for the appendix. If it be not discoverable, the cæcum is to be raised and search prosecuted behind it. Sometimes, however, this is impracticable, and at other times quite impossible. When, therefore, the appendix is not easily found, its location may be best ascertained by following down the band of unstriated muscle-fibres which appears on the anterior aspect of the ascending colon and leads down-

ward toward the origin of the vermiform process. Its location being thus indicated, it must be sought for in the thickened mass of exudate behind the cæcum. If found free, it is tied with or without an aneurism needle, its mesentery being ligated with it by a double ligature or not, according to circumstances. Sponges are then packed under it to receive any discharge, and it is cut away outside of the ligature, which should have been applied as close up to the cæcum as possible. Its stump should now be disinfected with hydrogen peroxide, and then seared with pure carbolic acid or the cautery. If this be done, it will not be necessary to enfold its end and apply sutures. Even if found buried in a mass of exudate, it should be treated so far as possible in the same way; but if the base of the stump of the appendix appear gangrenous, the dead portion should be removed and the stump disinfected, turned inward, and a few Lembert sutures introduced. Care should be exerted to collect upon sponges all pus or discharge or dead tissue, so that nothing may be left in the peritoneal cavity.

If operation be performed late, and after reasonable search one fails to recognize the appendix within a mass of more or less organized exudate or in an abscess-cavity, it will be best to discontinue search and prepare to drain the abscess. Should abscess be found between the layers of the mesocolon extending backward or upward, counter-opening should be made above the iliac crest. On the other hand, if an abscess has burrowed downward alongside of or near the rectum, it will be best to puncture above the sphincter, and by making a counter-opening in this way secure drainage by the introduction of a tube through the rectum.

Under all circumstances it is probably best not to flush the abdominal cavity with an antiseptic solution, but to collect on sponges or suitable substitutes all pus and débris, and with them to dry the exposed surfaces thoroughly. The only exception to this rule should be made in cases of diffuse suppurative peritonitis. A local abscess between the coils of the intestines may also be found, and should be first protected, and then evacuated in the same way.

Unless pus has been met with, the peritoneal cavity is not to be drained after the operation, but is to be completely and carefully closed. Should the abscess-cavity have been opened, it will then be necessary to drain with glass, or preferably with rubber tubing, the end of which is passed down to the stump of the appendix. About the tube should be packed a sufficient quantity of iodoform gauze, which may be allowed to come in contact with the intestines without fear. The incision should now be closed, save its lower opening for the exit of the drain and the end of the gauze which has been packed in. This gauze should be removed in from thirty-six to forty-eight hours, and it is well at this time also to remove the tube, unless discharge be con-

tinuous or insufficient. It is also well to insert secondary sutures, so that after removal of all drainage material the remainder of the abdominal incision may be closed without discomfort to the patient.

Between the above operation—which is made during perhaps the most acute portion of the disease—and deliberate operation between attacks of recurrent appendicitis there is virtually no difference, save that the latter are to be regarded in the light of prophylactic operative treatment, which should be undertaken and carried out when circumstances of time, light, and surroundings make the prognosis even more favorable for the patient.

PERITYPHLITIC ABSCESS.

THIS term may with some propriety be still applied to cases of circumscribed suppuration in the neighborhood of the cæcum, though we know that 99 per cent. of them are due to inflammation beginning in the appendix. Much discussion has arisen as to whether these abscesses are intra- or extra-peritoneal, difference of opinion arising from the supposed importance of such distinction in operating. It is one of little or no practical importance, however, since, whatever such an abscess may have been originally, by the time it assumes the importance of an abscess adhesions have shut it off from the general cavity and have made it practically extra-peritoneal, so that it can be opened usually through the iliac fossa.

Results of Operation.—The results of early removal of the appendix, even when pus has been present, have been for the most part favorable, and numerous lives have been saved which would otherwise have certainly been sacrificed. That it is well to remove the appendix when practicable is shown by the fact that cases are on record of recurrence with great violence in persons who had been operated upon, but the appendix not removed at the time. The conditions are quite analogous, and we may hold that it is as necessary to remove the appendix when we are operating for this purpose as to remove a pus-tube when we are dealing with a condition of pyosalpinx. Should peritonitis of the diffuse and suppurative variety develop after the operation, it would be best, probably, to open the abdomen and wash it out. The possibility of ventral hernia from incomplete or insufficient closure of abdominal incisions must be borne in mind, and care and forethought exercised at the time of the operation, looking to this possibility. Persisting fæcal fistulæ, which may result from operation for abscess, as already remarked, usually close spontaneously in time.

Should they fail to do so, subsequent operation for this purpose may be required.

Treatment.

Between the operative treatment of this condition and that for appendicitis there is no fundamental distinction, save that the operation is not usually quite so hurried, and can generally be postponed at least until daylight, and that one scarcely expects to meet with or remove the appendix, but rather simply to drain a large or small collection of pus through the most accessible and feasible route. An opening is now made over the most prominent part of the swelling, the incision being usually made parallel to Poupart's ligament. Now, ordinarily, as one approaches the abscess-cavity the deeper tissues are more or less infiltrated and altered in appearance and density, and the operator is usually made aware by the sensation conveyed to his finger of the proximity of pus. If during the endeavor to find pus the peritoneum should have been opened by mistake, it should be at once carefully closed and protected, and the search prosecuted in the direction indicated by the information revealed by the mistake. The abscess-cavity having been opened, the finger should be introduced and search be made for fæcal concretions or foreign bodies. Before final arrangements for drainage are made it will be well to wash out and cleanse this cavity, for which purpose hydrogen peroxide is the ideal material. A large drainage-tube surrounded with sufficient gauze packing should be inserted nearly to its depth, and over this a copious absorbing and antiseptic dressing applied. Should it be found that the abscess-cavity connects with the intestine, and that a fæcal fistula is the result, the treatment should, nevertheless, be the same, since experience has shown that most of these fistulæ close spontaneously, with healing and contraction of the old abscess-cavity. When one is quite uncertain in what direction to incise, although confident of the presence of pus, Stimson has recommended to begin the operation as if intending to ligate the external iliac artery, then to lift up the peritoneum from the iliac fossa, and thus open the cavity as it were from behind.

DISEASES OF THE RECTUM AND ANUS.

By CHARLES B. KELSEY, M. D.

Surgical Anatomy.

The rectum measures from six to eight inches in length in the natural position of the parts, but when dissected out it will be found to be a couple of inches longer, because of the straightening of the normal curves. Its upper limit is marked by a distinct constriction, which separates it from the sigmoid flexure, and which can easily be felt by introducing the hand through the anus. This constriction lies opposite the sacro-iliac synchondrosis on the left side, and marks the limit of safe manual examination. Weir in his measurements of the rectum found that a hand of less than 26 cm. in circumference could be introduced from 17 to 19 cm. without inconvenience, but not more. He found the greatest circumference of the rectum to be at 6 or 7 cm. from the anus, where it may reach 25 or 30 cm. At the upper part of the middle third it is not more than 20–25 cm., and thence it rapidly diminishes, being not more than 16–18 cm. at the middle part of the superior third, and still narrower at the constricted junction with the sigmoid flexure. A small hand may, therefore, be passed entirely into the rectal pouch without danger, and the first and second fingers may be passed into the sigmoid flexure for palpation, with the outer hand pressing into the pelvis from above. In this way the two hands may be brought into actual contact except for the separation caused by the abdominal wall and the gut, and many a diagnosis may be arrived at with absolute certainty which were otherwise impossible. To attempt, however, to pass any hand into the sigmoid flexure is attended by far greater danger than would be an abdominal section for exploration and diagnosis.

The rectum has two important curves—one longitudinal, the other lateral. The former follows in a general way the curve of the sacrum from the tip of the coccyx to the promontory. Below the tip of the coccyx it turns sharply backward to end in the anus. The lateral curve is toward the left in the great majority of cases, and this explains why in Kraske's operation of excision the incision is made along the left border of the sacrum. This curve, like the other, does not include the whole rectum, but only the portion between the third sacral vertebra and the left sacro-iliac synchondrosis.

The middle and upper portions of the rectum have important surgical relations. In the former these arise from the proximity of the urinary and genital organs to its anterior surface, the rectum being closely connected with the vagina in the female and with the base of the bladder in the male. The middle portion is covered on its posterior surface in whole or in part by peritoneum, and between it and the sacrum are the sacral plexus of nerves and the branches of the internal iliac artery. On both lateral surfaces it is in contact with loops of small intestine, which explains why in cases of rupture or of extensive prolapse we may have extrusion of many feet of small intestine through the anus. In front, in the male, it is also separated from the base of the bladder by coils of small intestine, while in the female it is in relation with the broad ligament, the left ovary and Fallopian tube, and the uterus and vagina. For this reason it often happens that a bimanual examination by the rectum in a female will give more exact information than a vaginal examination, for the fingers, instead of being stopped by Douglas's pouch, may, through the rectum, be carried behind and beyond it.

It follows from these relations that incisions which involve only the lower portion of the rectum cannot invade the peritoneal cavity, while those which involve the middle and upper portions are very likely to do so. The upper portion of the rectum is entirely surrounded by peritoneum, and generally has a mesentery of considerable length—three or four inches—though hardly anything in anatomy is more subject to variation than the length of the mesentery of the colon, sigmoid flexure, and upper rectum. This meso-rectum in the majority of cases will be found to extend as low down as the third sacral vertebra, from which point it is reflected over the sides and anterior surface of the gut to the uterus and vagina in the female or the bladder in the male, forming the cul-de-sac of Douglas. In thus passing from the sacrum to the base of the bladder or vagina the membrane covers more or less of the sides and anterior surface of the second portion of the rectum.

In the fold of peritoneum forming the meso-rectum are found the blood-vessels, nerves, and lymphatics going to the rectal wall; and the peritoneum, while it admits of the easy motions and changes in position natural in this portion of the digestive tube, does much to hold it in its proper relations, as will be seen by the fact that in cases of amputation of the lower end of the gut it is often impossible to pull down the upper portion till this membrane has been freely divided. In the fold of meso-rectum also we look for involved lymphatics in all cases of cancer of the rectum.

As there may be great variations in the length of the meso-rectum, so there may be in the height at which the folding from rectum to bladder or vagina which forms Douglas's pouch occurs; and this is

important in determining the limit to which incisions in the rectal wall may be carried without opening the peritoneal cavity. The distance of the pouch from the perineum is given by different authorities as from two to seven inches, but perhaps there are no more accurate measurements than those of Cripps, who sought to determine the point by injecting the pouch with plaster and allowing it to set, and then plunging a needle through the skin of the perineum till the point struck the plaster. In this way he found the average distance to be two and a half inches with the bladder and rectum empty, and three and a half inches when both are distended. These figures are, however, of very little practical value, on account of the great variations in different subjects. Naturally, the measurements are much less in new-born children, seldom exceeding one inch, showing the small depth to which an incision for imperforate anus may be carried without opening the peritoneum. In cases in which it is thought desirable the fold of peritoneum may be carried a considerable distance upward into the pelvis by allowing the bladder to become distended.

Passing now from the surgical relations of the rectum as a whole to its individual parts, there are several points worthy of careful note:

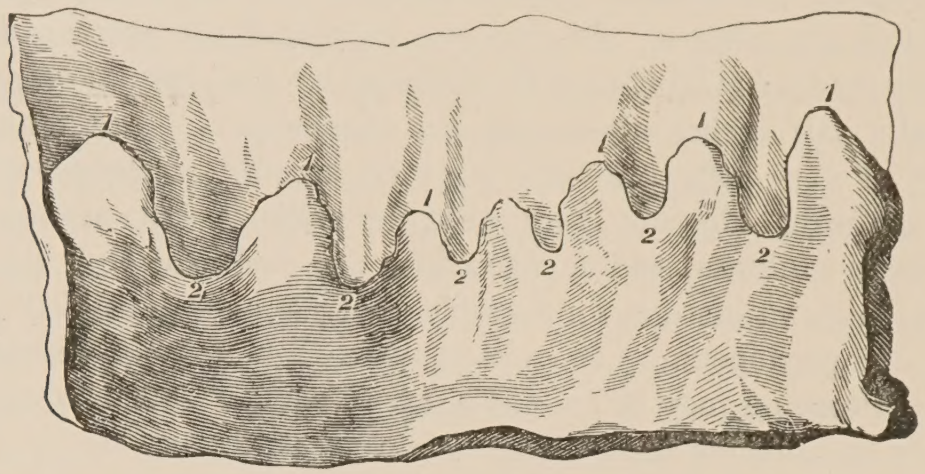
First, it may be well to call attention to the fact that there is no distinct line of demarcation between the rectum and anus. The anus is by Henle considered to be about one inch in length, and therefore to include that terminal portion of the gut which is grasped by the internal sphincter. The expression "fistula in ano" is thus a proper one for the milder forms of the disease, though many will be found to involve the rectum, and not the anus.

Hilton long ago called attention to a white line marking the point of junction of the skin of the perineum with the mucous membrane of the anus, also the point of separation of the external from the internal sphincters, and the place at which many of the terminal filaments of the internal pudic nerve perforate the wall of the gut. The line is by no means easily detected in most subjects.

At the point of union of the mucous membrane with the skin of the anus the former is gathered into vertical folds, which diminish when the bowel is distended, but are not entirely effaced. These have received from the older anatomists the name of *columnæ recti*, or columns of Morgagni, and between their lower ends little arches are sometimes found stretching from one to the other, forming pockets of skin and mucous membrane, as shown in the cut. These are more developed in old people, and doubtless may be the seat of ulceration and abscess due to the retention in them of small particles of fæces. Quite recently there has been considerable discussion concerning them, due to the fact that they have been brought into prominence by certain quacks, who attribute to them many obscure sensations about these

parts, and even provide for their division neat little blunt hooks and curved bistouries in the "rectal cases," which they advertise for the cure of all diseases of the rectum and anus. As a matter of fact, the pouches as distinct pouches seldom exist, though the folds from one column to another can often be seen without any depression into which

FIG. 57.



Columnæ Carnæ Recti and Sinuses of Morgagni.

a probe can be passed. When there is a pouch or cavity, it is as apt to run upward under the mucous membrane as downward, and small pits or depressions may often be found scattered irregularly in the anal mucous membrane. But, like most successful pieces of quackery, there is an element of truth in the midst of all the deceit, and so in this case there is no doubt that ulceration of one of the sinuses of Morgagni may in rare instances cause much pain about the anus, the real cause of which may easily be overlooked.

Passing upward from the anus, the chief point to be noticed regarding the mucous membrane is its great amplitude, which even when the gut is distended by a large speculum prevents it from being drawn smooth for examination. When the finger is passed into the normal bowel the folds of mucous membrane can be distinctly felt projecting into its lumen, and obstructing its passage. Attempts have been made by careful study to give these folds, which are generally transverse, a constant position, and even to give them separate names. In spite of the careful and elaborate work of Otis of Boston on this special point, I have not yet come to admit their anatomical constancy or regularity, and can go no further than Kohlrausch, who describes and figures one fairly constant fold, which he names the *plica transversalis recti*, projecting well into the lumen of the gut from the right side, forming rather more than a semicircle, and involving more of the anterior than the posterior wall. This duplicature of mucous membrane, strengthened sometimes at its base by an agglomeration of the circular involuntary muscular fibres of the gut, is all that there is to the popular and uncer-

tain so-called "third sphincter" of the rectum—the unlocated muscle which has been unnecessarily called into existence to prevent the passage of fæces from the sigmoid flexure into the rectum. As a matter of fact, the circular muscular fibres are gathered into groups at various points of the upper part of the rectum, and the mucous membrane is also folded upon itself transversely; but there is no constancy in the position either of the folds or of the strengthened muscular bands, nor do they seem to have any constant relation to one another. It is necessary to call attention to these folds to explain the difficulty often met in attempting to explore the rectum with the bougie, and the mistaken diagnosis of stricture high up often resulting therefrom.

With regard to the two real sphincter muscles, the external and internal, there are many points of surgical and physiological interest. The external is a voluntary muscle; the internal, located just above and partly within its grasp, is composed of involuntary fibres. The external is a broad but thin layer, elliptical in shape, spread out under the skin for about an inch on each side of the anus, but only reaching about three-fourths of an inch up the canal; while the internal is only 2 lines in thickness, but reaches up the canal half an inch. Both muscles vary much in their development.

These muscles are of the greatest possible surgical importance in all operations about the rectum, and no fibre of them should ever be cut unnecessarily. After forcible stretching they generally regain their tonicity in a few days. Only once have I seen anything approaching permanent incontinence follow this procedure, and in that case the stretching was unduly severe; and as time passed on they gradually recovered in a great measure their tone under proper treatment. In most cases it is safe to divide them both by a single incision, preferably in the median line, and they will regain their function after the incision heals, as is so often the case in fistula. A double division of both muscles should never be done unless in grave disease, when subsequent incontinence to a greater or lesser degree may be predicted, especially in women. The muscles should never be divided by a slanting incision when one directly across the fibres can be made to answer the purpose.

Although incontinence of fæces from incision and faulty union of the sphincters is a most serious condition, and one which would often be made public in suits for malpractice were it not for the delicacy of the sufferers, my own observation has tended greatly to surprise me by proving how very comfortable many people are who have absolutely no sphinteric control. To understand this, the function of the sphincters must be studied, and the first notion to be abandoned is the popular one that but for their action there would be a constant escape of

fæcal matter. This, except in cases of diarrhœa, is by no means the case. The function of defecation is a complicated one, made up of several physiological factors, and the sphincteric control is but one element in the whole—an element which frequently is absent without the knowledge of the individual. In the normal act of defecation the sphincter plays a very minor part. The solid fæcal mass is accumulated in the sigmoid flexure till the daily time for defecation comes. It does not press upon the sphincters, nor is it ready to escape at any moment when the voluntary contraction of the guardian muscle is relaxed. On the contrary, the first step in the composite act of defecation is an entirely involuntary increase in the peristaltic action of the sigmoid flexure and upper rectum, taking place at a certain hour every day, due perhaps to the pressure of an increased amount of fæces, but in great measure to what may, for lack of a better term, be called habit, and often seemingly dependent upon a certain routine—the morning meal, the hot drink, or the morning cigar. Following the involuntary increase in peristalsis, which causes the desire for defecation, comes the voluntary act composed of two factors—the first an active contraction of the abdominal muscles, and the second a voluntary relaxation of the sphincter, which is habitually in a state of tonic contraction. Should the sphincter be incapable of this tonic contraction, there would be no noticeable change in the sequence of events as far as the individual's knowledge extended, and the act would take place as it normally does. I have seen many men utterly without the power of contracting the sphincter muscle who went through the act of defecation every day, and told me they had perfect control when in reality they had none. The most marked case I ever have seen was one in which by extensive cicatrization after operation the lower three inches of the gut was converted into an open cicatricial canal, readily admitting at all times two fingers, over which the patient had absolutely no muscular control; and yet he did not know that he was incapable of performing any part of the act of defecation, for all of it, except the voluntary relaxation of the sphincter, was performed, as it had always been, once a day immediately after breakfast.

The function of the sphincter which is of greatest importance is the opposite of the one we have been considering. It is the voluntary contraction instead of the voluntary relaxation of the muscle, the loss of which causes the suffering when the muscle is wounded; and should an individual like the one just referred to attempt to postpone or delay the act of defecation he would instantly realize his incompetence. In cases of diarrhœa the act must often be delayed; the power to do this by voluntary sphincteric contraction is lost and hence the suffering. To the man or woman who never has diarrhœa the sphincter is of little

importance; to one suffering from intestinal catarrh life may become an almost intolerable burden.

It is well to bear this action of the muscle in mind in reading the reports of extirpation of the rectum and other grave operations, in which the statement is made, as it often is, that the patient has good sphincteric control except when the passages are loose. The patient who has "good sphincteric control except in case of diarrhœa" has very little if any control.

The external sphincter is supplied by the fourth anterior sacral nerve, as are also the levator ani, the coccygeus, the rectum, and the bladder. In doing high amputations of the rectum it is well, therefore, to avoid as far as possible the fourth anterior sacral foramen, through which this branch of the sacral plexus emerges. Bardenheuer's transverse section of the sacrum is made, however, at the level of the third sacral vertebra, and the fourth nerve sacrificed when necessary to remove extensive cancerous deposit. Paralysis of the bladder has been known to follow this high incision.

Examination and Diagnosis.

The first step in the diagnosis of any disease of the rectum is to obtain a clear history of the case. The patient may be able to give this intelligently, or it may have to be arrived at by careful questioning, but in one way or the other the surgeon must find an answer to the following questions: How long has the trouble existed? Is there any pain, and if so what is its character? Is there any protrusion of the bowel at stool? Are the bowels regular, or is there an escape of blood, pus, or mucus? Has there been any emaciation? When this information is obtained, more than half of the work is done, and sometimes the examination to follow may be almost a matter of form.

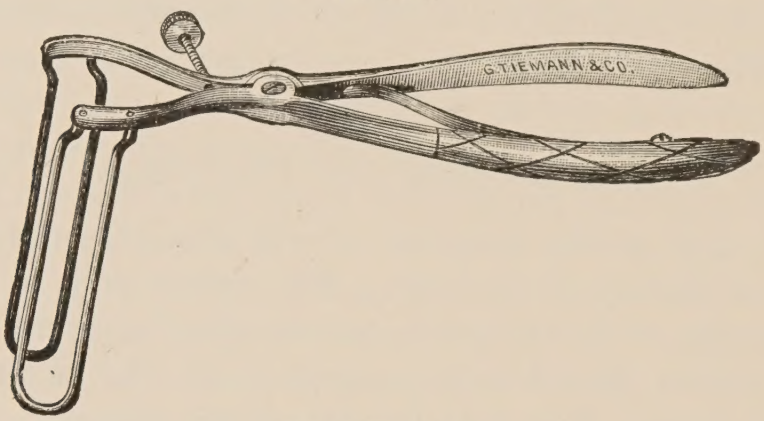
And yet the examination is never to be omitted, for it is simply wonderful how an intelligent patient may lead his physician astray by a verbal description of his symptoms. Patients will tell you they only have one passage a day, when they have been going to the closet ten or a dozen times every day for months, the passages of blood and slime not being counted, but only the solid fæcal matter. In fact, I have been deceived so often by the answers to this seemingly plain question that I have come to change the phraseology, and the question now is generally not how many passages do you have a day? but, how many times do you go to the closet in twenty-four hours?

The best position for examination in either sex is on the left side, with the knees flexed on the abdomen and the buttocks raised by a tilted examining-table or chair. In my own work I use a plain four-legged table which can be elevated at the foot. The only instrument

necessary for an ordinary examination is the index finger. By it, after the necessary skill has been acquired, the examiner can detect piles, fissure, fistula, abscess, and cancer; can diagnosticate between the different varieties of ulceration; and can tell the nature of a stricture far better than by sight.

The speculum is important, but is seldom used for diagnosis. Its greatest use is as an aid to treatment—to facilitate the making of applications to diseased surfaces. In an obscure case, where pain is complained of and digital examination is negative, the speculum should be used while the patient is under ether, and a careful search made over the lower three or four inches of the bowels. The best instrument for this purpose is the one shown in the cut. It is the rectal speculum of the late Marion Sims, only the blades are made fully an inch longer than in his. With this instrument and anæsthesia the

FIG. 58.

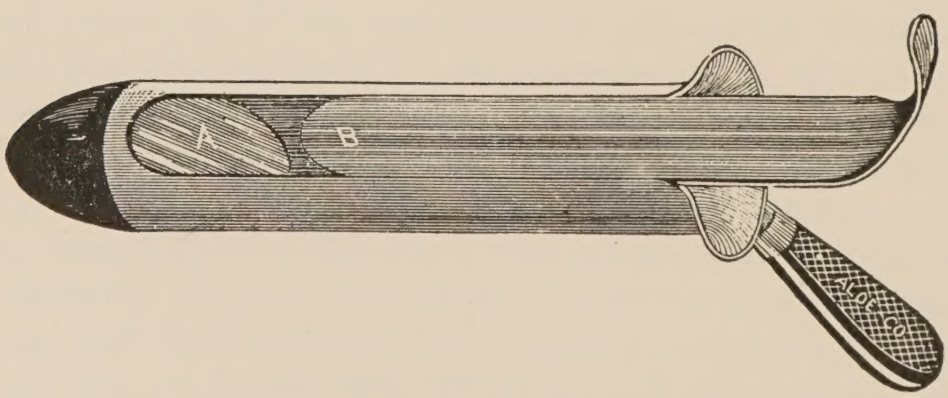


Sims's Speculum.

rectum can be carefully examined for the lower four inches, but to attempt to do so without ether will only be to inflict useless pain.

Another useful speculum is figured below. In it advantage is taken of the reflected image on the mirror (A), and an ulcerated

FIG. 59.



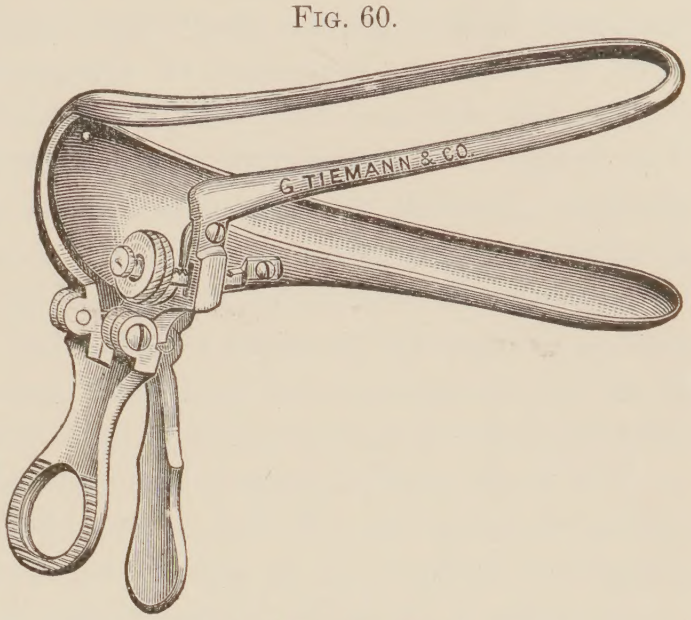
Aloe Speculum.

surface can be reached for treatment through the large fenestrum. This instrument is made in three sizes.

Still another which answers a very good purpose is one which I

believe is sold under my name, but for which I claim no originality. It is simply the old duck-bill vaginal speculum, with one blade fenestrated to the greatest limit possible. It is easy to introduce, gives as little pain as any, and does not put the parts so much upon the stretch as to distort the natural appearance, which I find a matter of considerable importance in some cases. A superficial loss of tissue, for example, in the mucous membrane looks very differently when seen through a speculum which stretches the surface to the point of fissuring than through one which allows it to fall evenly and naturally between its blades.

FIG. 60.



Author's Speculum.

One other variety which must not be omitted is the well-known Sims's vaginal speculum, with the groove for the sphincter as suggested by Van Buren.

With these instruments the surgeon's armament is as complete as it would be with more; and the older he grows in rectal surgery the less use will he have for any of them.

There is one other instrument useful in diagnosis when skilfully used, but liable in unskilled hands to lead to error, and even to irreparable harm—the bougie. Of this but one variety should be sold for exploration, or indeed, in the vast majority of cases, for any other purpose, and that is the flexible, red-rubber, perforated one known as Wales's. This comes in all sizes up to No. 12, which measures one inch and three-sixteenths in diameter. For ordinary exploration No. 7 or 8 will be found best adapted. There is no way to describe how to explore the upper rectum with this instrument. Even in the best of hands it may give valuable information or may lead to error. It should be used only after the gut has been thoroughly emptied by an enema, and should then be well oiled and passed gently upward till it stops, as it almost always will, at the promontory of the sacrum or in the sulcus formed by a fold of mucous membrane. It should be passed with the patient on the left side, to avoid the large fold of mucous membrane generally to be found on the right wall. When it has been stopped at this point, a Davidson's syringe should be attached to it and about four ounces of warm water thrown through it into the bowel. This distends the gut,

draws the folds out of the way, helps the instrument also past the promontory, and if no pathological obstruction is present allows it to be passed its full length—about twelve inches. But when this has been done, if there are symptoms of ulceration of the rectum or sigmoid flexure, the examiner may well be guarded in diagnosis and prognosis. The bougie has passed, it is true, but there may be fatal disease none the less. Positive evidence is here much more valuable than negative. If after proper trials I failed in my own practice to pass a medium-sized bougie on successive attempts, I should be willing to diagnosticate a stricture in the upper rectum; but it would not be safe to say there was no stricture and no extensive disease because the bougie had passed did the symptoms point to such disease.

Too much caution cannot be exercised in the employment of this means of diagnosis. With a heavy hand even a flexible bougie is a dangerous instrument to use in an ulcerated and thinned rectum.

In cases of doubtful disease above the limit of touch and vision there is still one method of examination better than all others. This consists in bimanual examination under ether, with one hand wholly or partly introduced in the rectum. With a small hand the whole rectum can thus be explored, and with deep pressure upon the abdomen the two hands can be brought near enough together to detect any decided thickening of the wall of the gut. To accomplish this it is not necessary, as a rule, to introduce through the anus more than the extended fingers and palm of the hand, and this procedure is attended by no great danger. It is different with the attempt to pass the whole hand and forearm into the sigmoid flexure, as has been done, for in this the danger of rupturing the bowel is imminent.

It will thus be seen that the whole question of diagnosis resolves itself into drawing correct inferences from the patient's history, and into recognizing what can be detected by the sense of touch—touch first with the index finger, next with the bougie, and finally with bimanual examination; and the greatest of all aids is anæsthesia. The rest must be learned by practice and experience. There is something characteristic in the feel of each disease which can never be described, but must be experienced. Rarely will the skilful examiner mistake cancerous deposit for dysenteric stricture, or tubercular for simple ulceration. About the most difficult of all affections for the beginner to recognize by the finger alone is hæmorrhoids.

For any delicacy of examination in an obscure case it is evident that the rectum must be absolutely empty and clean. For this reason a closet should always connect with the examination-room, not that an enema must be given to every case by any means, but in doubtful cases or those in which it is intended to use the bougie it is indispensable. Small particles of solid fæces held in the folds of the mucous

membrane may easily be mistaken for polypoid growths or for the roughened surface of an ulcer, and a patient can extrude his own piles, prolapsus, or polypus much more easily when sitting on the closet than when lying on the examiner's table.

Congenital Malformations.

Although no practitioner sees many cases of congenital malformation, the condition is not so uncommon but that any one may be called upon to treat it at any time, and very possibly when far removed from the opportunities for consultation. As far as my own experience goes, I am ready to believe that a majority of these cases occur in the lower walks of life, and, either from lack of diagnosis or from an ignorant dread of surgery on the part of the parents, are allowed to die unrelieved. Twice during the past year's hospital practice parents have resisted all my persuasion to allow me even to incise an occluding membrane when the little sufferers were in the midst of severe intestinal obstruction.

To understand properly the varieties of this condition it must be remembered that the rectum and anus are developed from different layers of the blastodermic membrane—the former from the internal and middle layers, the latter from the external. The primitive intestine terminates at first in a cul-de-sac common to it and the urachus. About the eighth week a partition is formed dividing this cavity into the rectum and the uro-genital canal, the partition being the perineum. At the same time a depression is being formed in the skin at the site of the anus, which, gradually extending upward, unites with the blind rectal pouch about the end of the fourth week. All of the malformations found at birth are due either to a failure to form a suitable depression in the external blastodermic membrane for the anus, to a failure of the rectal cul-de-sac to descend low enough to meet the depression thus formed, or to a failure to form a perfect perineum and septum between the rectum and the uro-genital canal.

The varieties of malformations may be arranged into various groups. The simplest of all is a mere narrowing of the rectum or anus at some point without complete occlusion—a congenital stricture of greater or less calibre. This narrowing may be very slight, or may reach a degree which hardly admits the passage of meconium. In the former class of cases the condition may never cause any symptoms, and is very likely to go undetected till the patient reaches adult life. It is a curious fact that many of these cases go to adult age without complaining of anything but chronic constipation, and yet after a certain time of life begin to show all the symptoms of stricture with ulceration. This clinical fact has been explained on the ground that in infancy and youth the tissues have no

tendency to contraction or induration, but, on the contrary, are supple and elastic, and the function of defecation is carried on without great difficulty in spite of the obstacle; while at a later period the trouble becomes more marked, there is increasing obstruction, the embryonic tissue begins to degenerate, and ulceration is added to the obstruction.

In treatment this embryonic tissue will be found very rebellious and unyielding to anything but the knife. Dilatation may accomplish good, but complete division and subsequent dilatation will do much more.

This form of disease must not be confounded with the one now to be described, in which either rectum or anus is occluded by a mere membranous diaphragm drawn across it like the hymen, and being completely impervious or having perhaps several openings. The membrane may be of greater or less firmness, and may be composed either of skin or of mucous membrane. It may be thin enough to bulge with meconium when the child strains, or even to rupture spontaneously. This is the simplest of all the varieties to treat, yielding readily, as an imperforate hymen would do, to a crucial incision; but, unfortunately, it is also one of the rarest forms of the disease.

We come now, naturally, to the more serious forms of these affections—conditions which may confront the practitioner at any moment, and which require a considerable degree of surgical knowledge for their proper treatment.

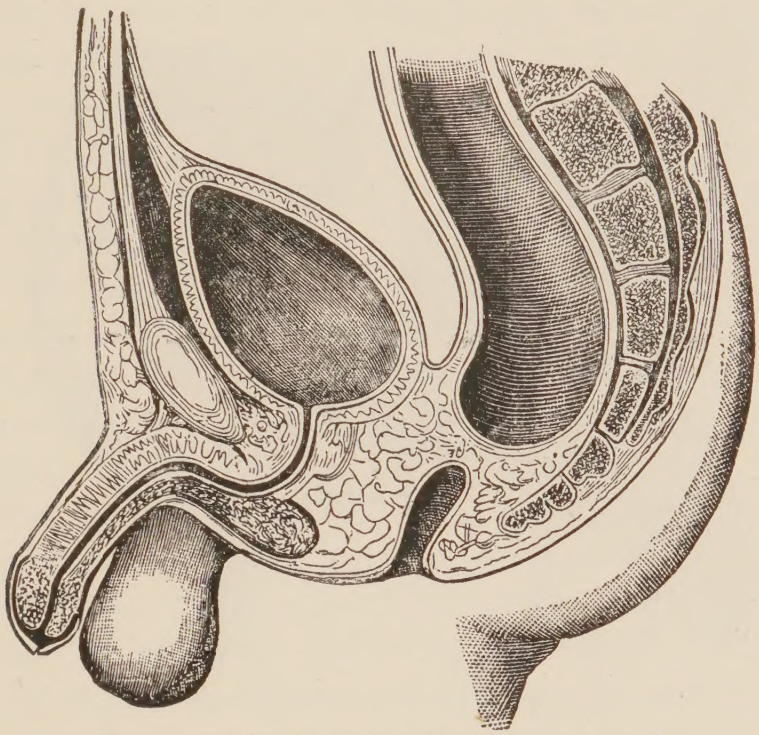
The third class of malformations includes all those cases in which there is an entire absence of the natural anus and the rectum ends as a cul-de-sac at a greater or less distance from the skin. Some of these cases are marked by a slight dimple at the point where the anus should be; in others the perineal raphé extends directly over the spot. The presence of a dimple is not to be considered as an indication that the cul-de-sac is any nearer the surface than it would be were the raphé well marked. The external sphincter is also sometimes well developed, and at other times entirely wanting. A distinct fibrous cord may be present leading from the cul-de-sac to the skin, or the rectal pouch may hang free in the pelvis or be attached to some adjacent part.

The fourth variety includes the cases in which the rectum ends as above, but where the anus is normal. In these cases the septum is composed of fibrous tissue lined both above and below by mucous membrane, and it is not, as in the second variety, merely a membranous partition, though it may be perforated and allow of a slight dribbling of meconium.

In another variety the anus is absent and the rectum ends by a fistulous opening somewhere in the perineum or sacral region, and in still another variety the anus is also absent and the rectum terminates in the urinary or genital tract. Forty per cent. of all cases will be

found to come under this latter class, and the variety in which the rectum ends in the vagina is the most common. In females the opening

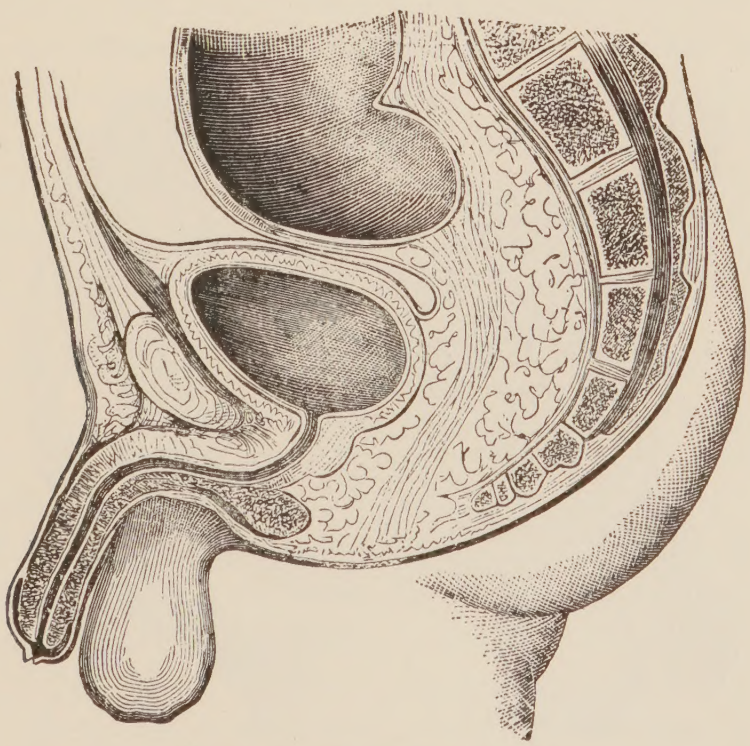
FIG. 61.



Rectum ending in a Blind Pouch, anus normal.

is very rarely into the bladder, while in males it is more often into the bladder than into the urethra. In males, when the communication is ure-

FIG. 62.

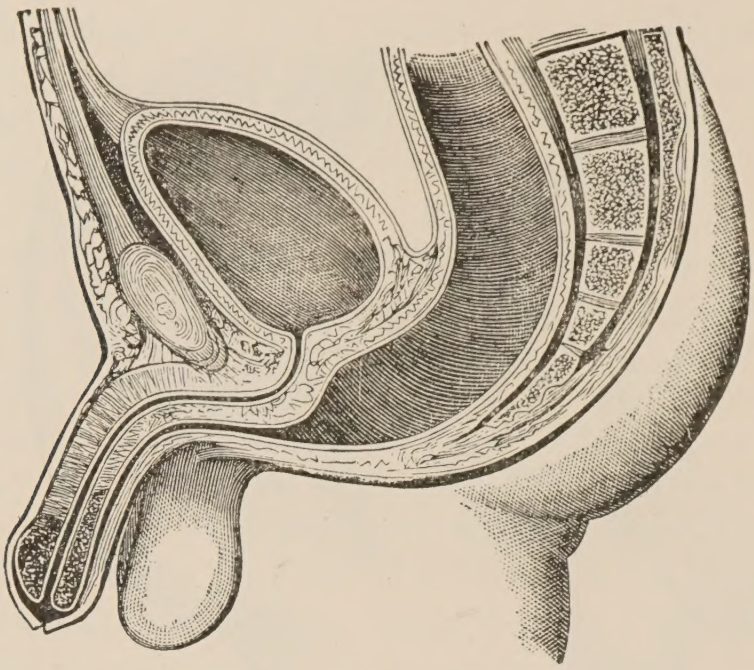


Same as last, with Absence of Anus.

thral, the meconium will at times dribble away from the meatus independently of the act of urination, and, though the first flow of urine may be mixed with meconium, the remainder will be clear. When the

communication is with the bladder, the whole of the urine will be thick and greenish, and the condition is much more serious. Children with

FIG. 63.

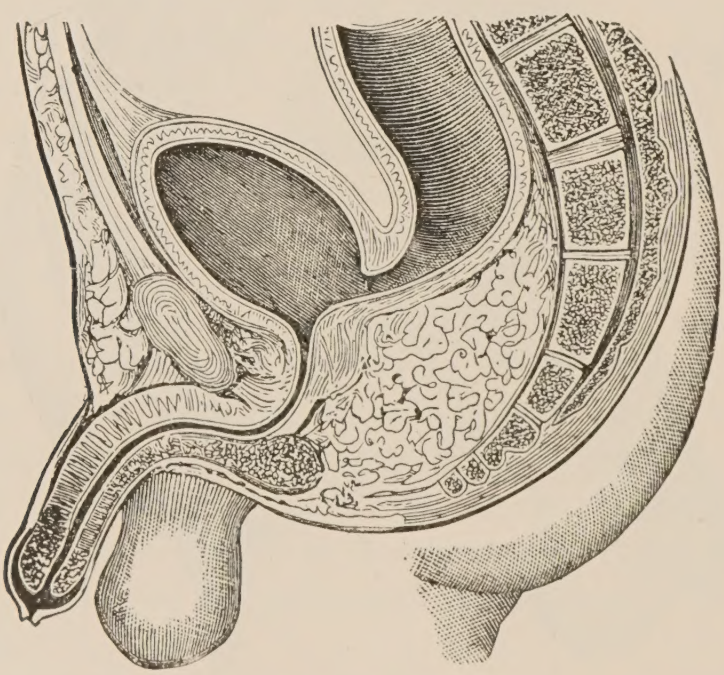


Rectum ending in Fistulous Track.

a vesical opening are, as a rule, quickly exhausted by the resulting cystitis, but with an urethral opening the patient may reach adult age.

In the diagnosis of the third and fourth varieties it is naturally of the utmost importance to determine the position of the rectal pouch and

FIG. 64.



Rectum ending in Bladder.

its distance from the surface of the perineum. In some cases a bulging and fluctuation on coughing or crying will indicate that the cul-de-sac is only a short distance from the skin or from the bottom of the anal

depression; but these cases are rare, and any attempt to cause bulging by the administration of a laxative is unjustifiable.

In a general way it may be said that if the pelvis is normal in its measurements and the external genitals show no malformation or lack of development, there is a probability that the defect in the rectum is not of the most serious kind, and the pouch is pretty near the surface. Nearness of the tuberosities, on the other hand, is a sign that the cul-de-sac is high up; and vaginal exploration may be of great assistance, for if the vagina or bladder take the place in the hollow of the sacrum which should be filled by the rectum, the indication is plain.

In the treatment of these cases we must be guided by the accumulated experience of many men rather than by individual opinion. Collected and analyzed, the cases give results from which clear general rules of practice may be deduced.

In the first variety the treatment has been indicated. In the class of thin membranous septa life may be prolonged and the child may be cured by nicking and subsequent dilatation. Difficulty may be experienced in deciding when this plan is applicable to the fourth class; but when the septum is firm and unyielding, even though meconium may dribble through it, treatment by nicking and dilatation will only give temporary relief, and the calibre thus gained cannot be maintained by the use of bougies.

In the fourth variety an exploratory operation should always be undertaken to try and reach the cul-de-sac, and failure to accomplish this should be followed immediately by left inguinal colotomy. If the rectal cul-de-sac be reached, it must be drawn down and attached to the skin of the anus, so that the incision through the perineum may be furnished with a mucous lining, otherwise it will immediately contract into a mere fæcal fistula, which will eventually cause the death of the little patient, and which can never be kept open by bougies.

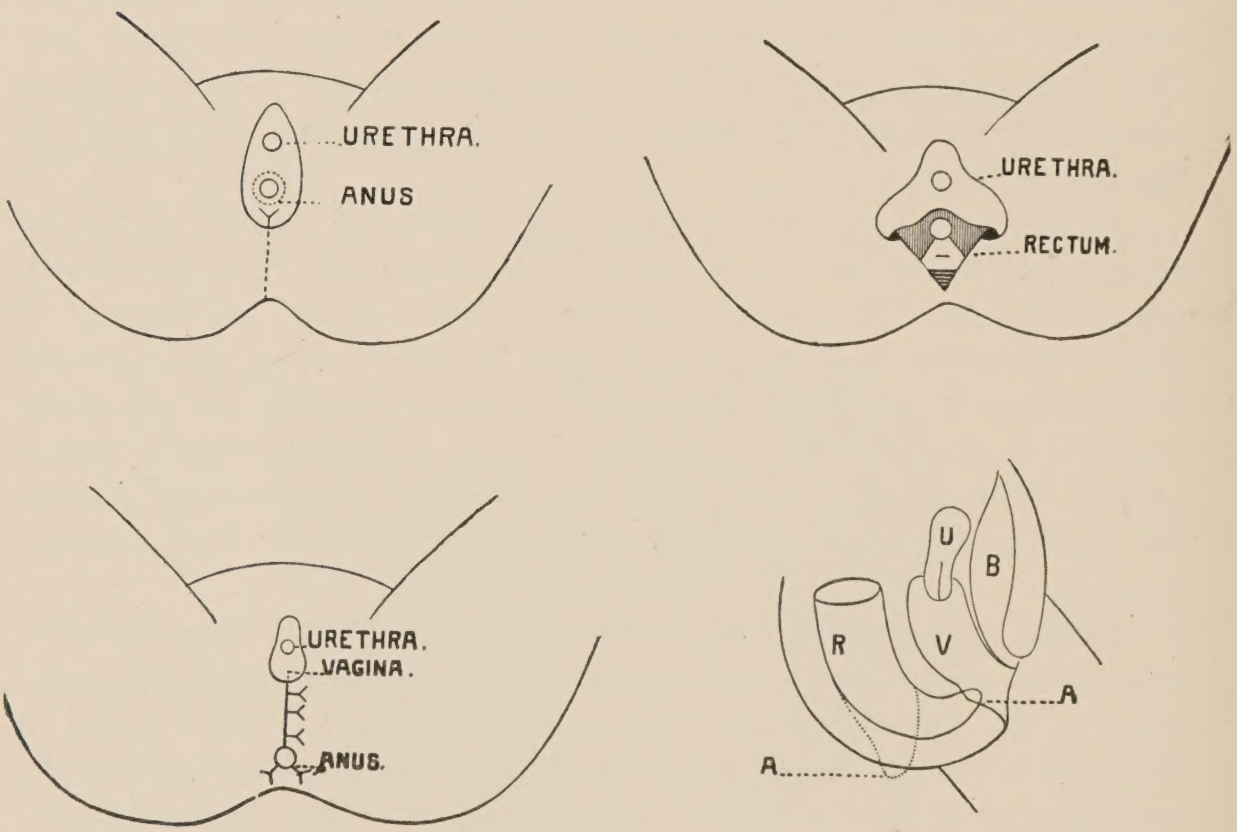
In this operation the cutaneous incision should reach from the scrotum to the tip of the coccyx, and should be carried upward and backward in the direction of the hollow of the sacrum. With a sound in the male urethra or female vagina, and frequent use of the finger in the incision and deep pressure on the abdomen to detect fluctuation, the incision may be deepened stroke by stroke until it has extended an inch or an inch and a half, when, if the pouch be not reached, it should be abandoned. The use of a trocar through the incision is evidently unsurgical. Even when successful in finding the pouch, the puncture does no good, and the bladder, uterus, or peritoneum are much more liable to be punctured than the cul-de-sac. Again, the cul-de-sac often hangs loose in the pelvis and is covered by peritoneum, so that its puncture in this way is merely the cause of fæcal extravasation into the

peritoneal cavity and death. In Cripps's table there are 14 deaths in 17 punctures with the trocar.

In cases where the cul-de-sac has been reached by the perineal incision it may not be possible to draw the end of the gut down and attach it to the skin at the site of the normal anus. In such the coccyx should be excised to allow room, and the anus established at that point.

In the cases in which the gut terminates by a fistulous opening in the perineum or in the urethra, an attempt should be made by free incision to find the cul-de-sac and bring it to the surface, either in the perineal or sacral region, as in the last class of cases, and failure to do this should be followed by colotomy. In the variety of recto-vesical fistula colotomy should be done without previous perineal search. In the cases of urethral fistula the surgeon may delay operation for a time if there be no signs of intestinal obstruction or if the malformation be not exhausting the little patient by irritation. Some of these cases

FIG. 65.



Rizzoli's Operation.

seem to suffer little from the condition, and every week that can be gained renders the pelvis larger and the operation proportionally easier; but the watch kept on the patient's condition must be very close.

In the cases of recto-vaginal fistula the problem is easier, because the opening is generally large enough to prevent intestinal obstruction

or can be made so by gentle digital dilatation, and operation can be postponed till the pelvis has had time to develop. The operation of Rizzoli should then be performed.

With the patient in the lithotomy position a sharply-curved vesical sound is passed into the rectum through the vaginal orifice. An incision is then made in the median line, reaching from the margin of the anal orifice in the vagina to the tip of the coccyx, and carried deeply enough to reach the surface of the rectum, but not deeply enough to cut into it. The dissection of the rectum must be continued cautiously till it is completely freed from its attachments, and the incision must be carried around the vaginal anus with its sphincteric fibres till it can be transplanted without much traction into the posterior angle of the cutaneous incision, as near as possible to the coccyx. The separation of the rectum on its anterior surface should be complete. The margin of the anus is next to be stitched to the cutaneous surface; the sides of the vagina are then approximated; and lastly, the perineum is repaired.

Proctitis and Periproctitis.

Simple proctitis may be either traumatic or catarrhal.

Traumatic proctitis may be due to any sort of violence, and perhaps that arising from the too frequent or rough use of the syringe is the most common. Foreign bodies are sometimes introduced into the rectum in gratification of erotic desires, and set up severe inflammation. There is a school of quackery in our country which rests mainly on the use of a hard-rubber syringe for the patient's self-treatment. The nozzle is long, and bent at a right angle to the cylinder, and the brain of the quack is exercised in telling the patient just where on the posterior wall of the rectum his "ulcer" is situated, and in putting an umbrella ring round the long nozzle of the syringe, so that it may reach just to the proper point and stop. The patient then throws a forcible stream of medicated fluid or hot water against exactly the same point in the rectum daily till the ulcer which he is supposed to be curing is no longer a delusion, but an actuality.

The worst case of traumatic proctitis I have ever seen is now under my care, and has been for some months. It arose from the injudicious use of topical applications to a supposed stricture of the rectum through a speculum. The applications were made four times a day, and the patient tells me they were composed of some acid. At all events, the proctitis ended in an ulcer three inches long by one and a half wide, which resisted all treatment for many months, but finally yielded to prolonged rest and diet.

Catarrhal proctitis may be acute or chronic. The acute form is more often due to the retention of hard scybalous masses than anything else. Another frequent cause is too active purgation often

repeated. Servants who live upon liver pills or some other patented cathartic suffer from this, as do also children with pin-worms. Chronic proctitis, generally circumscribed, is not an uncommon result of the pressure of a heavy or misplaced uterus upon the gut, and is almost always associated with benign polypus. It would seem as though the new growth acted as a foreign body and produced inflammation in the surrounding mucous membrane merely by mechanical irritation. These cases are often very severe, and are always incurable till the polypus has been removed.

Esmarch and Bushe both give the gouty diathesis as a cause of chronic proctitis, and treat it by the usual remedies for the condition. In almost all cases of prolapsus, hæmorrhoids, or benign growths of the rectum a certain amount of chronic proctitis will be found associated.

Besides these causes of acute or chronic proctitis, there are certain specific poisons which will produce the disease. These are gonorrhœa, dysentery, and diphtheria. Gonorrhœa and dysentery will be more particularly referred to under Ulceration and Stricture. Diphtheritic proctitis is a local manifestation of the general poisoning, exactly analogous to the inflammation of the air-passages and attended by the production of the same exudate—in males in the rectum, in females generally also in the vagina.

In the acute variety of catarrhal proctitis the inflammation does not extend deeper than the mucous membrane, which is congested and hyperæmic. In the chronic the inflammation involves the submucous and muscular layers. The acute variety generally ends in resolution in a week or a fortnight when the cause can be removed, but it may go on to actual destruction of tissue and death of the parts. The chronic results in infiltration and thickening of the wall of the gut, which may end in superficial or deep ulceration.

The symptoms in the acute form are heat and weight in the part, with pain involving the uterus, bladder, and sacrum and radiating in all directions. The anus becomes red, excoriated, and painful, and sometimes the mucous membrane may become slightly everted from swelling. The evacuations are frequent and painful, and sometimes streaked with blood, every particle of fæces acting as a direct irritant to the involved mucous membrane. In the more severe forms there is a train of constitutional symptoms added to the local ones.

In the chronic form of the disease the symptoms are all less marked, but equally significant. The diarrhœa and tenesmus may alternate with constipation, and the discharge ceases to contain blood and is composed of mucus voided only with the fæces. The pain in great measure disappears, and leaves only a sense of weight and uneasiness to mark the condition.

The treatment of proctitis consists first of all in removing the cause. If hæmorrhoids are at the bottom of the trouble, they must be removed; so also with polypus. If the uterus be at fault the case should be handed over to the gynecologist. After this has been done the treatment is both local and constitutional. Absolute rest in bed, a diet of milk, meat, and eggs, daily evacuation of the bowels, and sedative enemata of starch, bismuth, and opium, will generally suffice in a few days for an acute case. In the chronic form local astringents may be necessary, and, unless the disease be well circumscribed, these should be made by enemata and not through the speculum, which is in itself an irritating mode of treatment. Sulphate of zinc, tannin, and weak solutions of nitrate of silver may be tried in turn. For the treatment of the cases in which ulceration has resulted the reader is referred to the section on Ulceration.

Periproctitis may be circumscribed or diffused, and may be the result of direct traumatism, but is generally septic. In the diffused form it is the most frequent cause of death after operations upon the rectum. It is analogous to septic peritonitis following childbirth, and in its clinical history strongly resembles pyæmia. The report of a single case will convey a clear idea of the disease. In about forty-eight hours or three days after an operation the patient has a chill and a sharp rise of temperature, sometimes to 105° F. Almost immediately a careful examination will reveal somewhere in the pelvis or buttocks a brawny swelling, which is tender on pressure and perhaps red on the surface, but contains no pus. If the inflammation be very deep, this may first appear several days later above Poupart's ligament. Great sloughing is sure to result, and the patient is most likely to die of chronic pyæmia and exhaustion. In one of my own cases, in spite of very free incisions into the buttock and perineum, the sloughs steadily continued for weeks, causing frequent hæmorrhages, opening into the rectum in two places, and finally into the bladder, and causing the death of the patient by exhaustion. In another no incision was possible; the inflammation first showing itself by the infiltration of the right side of the abdominal wall above Poupart's ligament, and steadily advancing in the cellular plains till it reached the axilla. The only treatment for the condition is free incision as soon as the inflammation can be detected.

In the circumscribed variety the prognosis is less grave, though large abscesses result and cause bad fistulæ. Here also deep incision and free drainage are the only proper treatment.

Abscess.

Superficial abscesses around the anus may arise from a multitude of causes. The simplest form is that which originates in the delicate skin

of the margin of the anus, either from slight traumatism or irritation, or from inflammation of one of the glands with which the part is studded, or the suppuration of an inflamed cutaneous tag of skin or external hæmorrhoid.

This form of abscess is always distinctly circumscribed, causes intense pain, and ends in rupture on either the cutaneous or the mucous surface, almost invariably producing in the end a small superficial fistula. I have seen several examples of this trouble from the use of carbolic-acid injections into hæmorrhoids, the injection causing suppuration beneath the pile, and the pus finding its way to the surface just at the verge of the anus.

Inflammation at this point seldom ends in resolution, and as soon as there is any evidence of pus the knife should be used. Much discussion has been indulged in as to the proper incision in these marginal abscesses, whether a mere free evacuation of the pus is all that is necessary, or whether the usual operation for fistula should be performed, notwithstanding the existence of only an external opening. I have tried both ways many times, but seldom have succeeded by cutaneous incision into the abscess-cavity alone in preventing a subsequent opening on the adjacent mucous surface; and my present practice is, after making a cutaneous incision, to pass a director to the point where the wall of the abscess on the rectal side is the thinnest, perforate the gut at this point, and cut as for fistula.

An abscess within the rectum may at any time result from the suppuration of an internal hæmorrhoid, and may end either in a bad form of ulceration or in a blind fistula of the internal variety. This is another not infrequent result of the method of curing hæmorrhoids by injections.

One other form of superficial abscess arises from suppuration of the subcutaneous connective tissue. This may be due to any traumatism, to exposure to cold, as sitting on a damp seat, or, in proper subjects, to tubercular ulceration at the margin of the anus. In the latter class of cases a slight perforation of the mucous membrane from the breaking down of the tubercular deposit is the first step, and the acute inflammation of the adjacent cellular tissue the result. These cases may be attended by very slight symptoms while quite large collections of pus are forming.

There is but little hope of resolution in these subcutaneous abscesses also, and an early free incision should be made as soon as pus has formed. If the wall of the abscess has approached so near the gut that only the wall of the gut shuts off the abscess-cavity from the rectum, perforation is almost certain to occur, as in marginal abscesses, in spite of a cutaneous incision; and the better practice is to break through this barrier with a director and divide the sphincters. In tubercular patients

more than this must be done. In such cases the abscess always has an internal orifice, and means must be employed thoroughly to destroy all the tubercular deposit. This is best done with the Paquelin cautery, but the sharp curette may be substituted.

A more serious form of abscess around the rectum is that which originates in the ischio-rectal fossa or in the space bounded by the levator ani above and the skin below. Here also traumatism plays an important part in the causation, but another kind of traumatism is to be looked for. The presence of foreign bodies, either swallowed, such as fish-bones, or introduced *per anum*; the violent use of the syringe and the perforation of the rectal wall by the end of the pipe; and the inflammation so often seen in connection with old strictures of the rectum,—are all active elements in the causation of this variety of disease.

Abscess in this locality shows itself by all the usual signs of acute inflammation. There may be considerable constitutional disturbance, chill, and rise of temperature; and there will be local pain, tenderness, and a hard swelling. The pus, if left to itself, finds its way eventually to both the cutaneous and mucous surfaces, and a deep fistula is the result. The deep urethra may be pressed upon, with resulting retention of urine. This is a thing which should always be guarded against in any of the more serious abscesses of this part. Several times I have seen it overlooked where the condition was perfectly evident, the patient's complaints being all referred to the abscess; and in one very sad case I saw the life of a strong young man sacrificed.

Doubtless, an abscess of the ischio-rectal fossa may undergo resolution with any kind of treatment or with none at all, but it seldom does. The proper treatment is an early and free use of the knife, the design being to prevent the formation of the fistula which is almost certain to be the result when nature is left to its own course. As soon as the hard, brawny swelling appears, without waiting for pus it should be freely incised. Ether should be given, and a fine, straight bistoury should be entered at the centre of the swelling and pushed straight forward parallel with the gut, till pus issues by the side of the blade if pus be already formed. When it is certain that the centre of the abscess has been reached, a generous incision should be made as the knife is withdrawn. Into this incision the finger should be passed, and all partitions and sloughing tissue broken down, the cavity being scraped out as far as possible, and irrigated with bichloride solution, 1 : 2000. Again, the point will arise as to the propriety of cutting into the gut, as in the usual operation for fistula, and this must depend upon the condition of the parts. If the abscess be only three or four days old, if after thoroughly clearing out the cavity a considerable wall of healthy tissue be found between it and the mucous membrane, the abscess may

be treated as one elsewhere, having no connection with the rectum, would be. In other words, the cavity may be filled with iodoform gauze, and it will heal from the bottom and no fistula be formed. This is the object of the early incision. But if, when the incision is made, nothing but the wall of the gut separates the rectum from the abscess-cavity, this work of perforation may as well be completed by the surgeon and the sphincters divided, for in most cases no amount of care will prevent the formation of an internal opening.

There is still another variety of abscess much rarer than any of those already mentioned, and much more serious. The superior pelvi-rectal space is described by the French anatomists as contained between the superior aponeurosis of the levator ani below, the peritoneum above, the rectum, and the walls of the pelvis. It has a variable extent in different subjects, and especially varies according as the levator is relaxed or contracted. Its greatest extent is reached when the muscle is in repose. At its anterior part the pelvi-rectal space is much less extensive than at the sides or behind, because the peritoneum is much lowered in front of the rectum to form the recto-vesical cul-de-sac, and gradually rises behind to meet the sacrum; and the plane of the levator is in a reverse direction to that of the peritoneum, and inclines from the prostate to the coccyx. The two planes are separated in front only by a few millimetres, while behind they are several centimetres apart. An abundant cellular tissue with large and lax meshes fills this entire space, and communicates with that of the iliac fossæ and the deeper regions of the abdomen through the medium of the subperitoneal cellular tissue of the pelvis, and in women it is continuous with the cellular tissue of the broad ligament. Behind, it is continuous with that of the meso-rectum and the concavity of the sacrum, and it communicates with that of the gluteal region through the sciatic notch.

In this space between the peritoneum and the levator abscesses occasionally form, and from the anatomical description it is easy to understand why they may assume such vast proportions, burrowing laterally into the subperitoneal tissue of the iliac fossæ, discharging into the bladder, vagina, or rectum, mounting upward and pointing in the groin or loin, passing downward through the sciatic notches into the thigh, and causing by their pressure retention of urine or acute intestinal obstruction.

These abscesses are due to the causes already described, and to some others. They sometimes follow childbirth, and may be due either to direct injury by the head of the fœtus or to septic poisoning. They are also secondary to diseases of the urinary organs, as gonorrhœa, acute inflammation of the prostate, or rupture of the urethra and extravasation of urine. A hairpin introduced *per anum* has been known to perforate the sigmoid flexure and cause fæcal abscess open-

ing in the lumbar region, over the great trochanter, and finally in Scarpa's triangle.

The symptoms are often surprisingly obscure for the gravity of the disease. There is more or less vague pain in the pelvis and lumbar region, which is seldom intense, but is generally increased by defecation. Fever may be entirely absent, is seldom continuous, and chills are only occasionally met with. On the other hand, the patient may rapidly sink into a typhoid condition, with high temperature and diarrhœa. Vesical symptoms are apt to be more marked than rectal ones, and there is apt to be retention of urine.

To show how insidiously the disease may advance, I may say that not long ago the house physician of a hospital asked me to look at a man, supposed to be rather a medical than surgical case, in whom he thought he detected an induration in the iliac fossa on the right side. The patient had scarcely any history except that of some wandering pain in the pelvis, which on deep pressure he located rather toward the right side. His temperature had been taken for some days, and occasionally showed a rise of a degree, but was generally normal. There were no other symptoms. I detected no fulness in the right side, but on making a rectal examination found a large tumor above the prostate. The diagnosis of deep pelvic abscess was made, but was considered so doubtful, I think, that when I proposed to the house physician that he should operate, he was not at all anxious to do so. A knife passed into the tumor through the rectum made the diagnosis quite plain by the evacuation of eight or twelve ounces of fœtid pus.

I have seen these abscesses in young children—once in the case of a boy of five years—and several times before the age of puberty.

The diagnosis will in not a few cases be made only after there has been a free discharge of pus by rectum, bladder, or vagina, but rectal examination in cases of obscure pelvic pain cannot be too strongly insisted upon, as it will often render an otherwise obscure case perfectly plain. It must not be forgotten that pus in this location may form entirely independently of the rectum, and may be due to appendicitis, to caries of some adjacent bone or of the spine, or even to suppuration around the kidney or liver.

The prognosis is always grave. The patient is exposed to the dangers of pyæmia, peritonitis, and phlebitis, and, even should the pus find a favorable point of exit, to the exhaustion of prolonged suppuration with its secondary visceral complications. When the abscess finally heals there is also danger from the cicatricial contraction, resulting, as it sometimes does, in occlusion of the rectum high up; but abscesses in this locality, even after free opening, may refuse to heal on account of the constant motion of the parts in every act of respiration.

According to the statistics of Ségoud, 35 of these abscesses per-

forated the urethra and 77 other parts, generally the rectum, but occasionally the perineum, the ischio-rectal fossa, and the obturator foramen. 20 per cent. were fatal, and many left fistulous communications with the rectum or urethra which did not heal.

The treatment may be included in two words—incision and drainage. My own rule is to cut at the point to which the pus seems naturally to be tending, whether in the rectum, vagina, or peritoneum, or above Poupart's ligament. The incision must be free enough to permit not only the escape of pus, but the introduction of one or two fingers to clean out sloughing tissue, the introduction of suitable drainage and of free irrigation. A careful dissection from the perineum into the abscess-cavity has been recommended as affording the best possible outlet, but this is not always practicable, nor will an opening made here always prevent the pus from subsequently finding its own way out at a different point.

Fistula.

Fistulæ, like the abscesses of which they are the remains, may be divided into superficial and deep, or those of the skin and subcutaneous tissue, which involve only the external sphincter muscle, and those of the rectum proper, which have their internal openings higher up in the gut and arise from abscesses of the ischio-rectal fossa and the pelvi-rectal space. Each of these classes may also be divided again into three different forms—those which have an external opening only, those which have only an opening into the rectum, and those which have both, though these distinctions are of but little practical importance. There may be two or three external openings in a small subcutaneous fistula and no internal opening, and scarce any two fistulæ are alike.

The external orifice of a small fistula may be so small as to escape detection in a cursory examination, and may keep the parts soiled with a discharge the origin of which may be hard to discover. To the educated finger the internal orifice is generally appreciable as a small raised papule between the two sphincters. In any case where the existence of an internal opening is in doubt milk may be injected into the track or abscess-cavity through the cutaneous opening. If the milk finds its way into the rectum, the proof is complete, but I do not know that it is of any special value.

Mistakes in the diagnosis of fistula are most likely to occur where an internal opening alone exists. The patient complains of pain and discharge of pus and mucus *per rectum*, and yet examination reveals nothing. These are the cases that go for years from one doctor to another without relief, and the secret of the diagnosis will be found to lie not in speculum examination for the cause of the discharge, but in

careful digital palpation of all the parts for deep induration. A lump may be felt under the skin, which, being pressed upon, will cause a flow of pus into the rectum; or when the finger is passed into the bowel a distinct swelling may be detected under the mucous membrane, and with a speculum to hold the anus open the orifice can be detected by pressing a few drops of pus out of it.

These are very interesting cases. Sometimes a small ulcer marks the internal orifice of such a fistula and completely deceives the examiner, but the ulcer never heals till the track leading away from it is found and laid open. I have seen a number of such cases as these following the injection treatment of piles; and indeed this constitutes one of the great objections to that treatment. The carbolic acid placed in the substance of the tumor causes a small slough and some burrowing in the submucous tissue. An ulcer of greater or less dimensions and a fistulous track an inch or so in length, running upward from the ulcer, are the results, and the patient is in a much worse condition than before.

There is another variety of fistula with an internal orifice only, which has a special pathology. A tubercular deposit in the glands of the rectal mucous membrane softens and leaves a small ulcer. The ulcer, constantly subject to irritation, perforates the wall of the gut, and sets up an abscess in the perirectal cellular tissue, and a fistula with internal opening results. In these cases the pathology is generally plain, from the fact that the opening is much larger than it would be did it represent merely the point of breaking of an abscess. The finger in the rectum in such cases shows a large ragged orifice in the wall of the gut through which the end of the index finger readily enters an abscess-cavity.

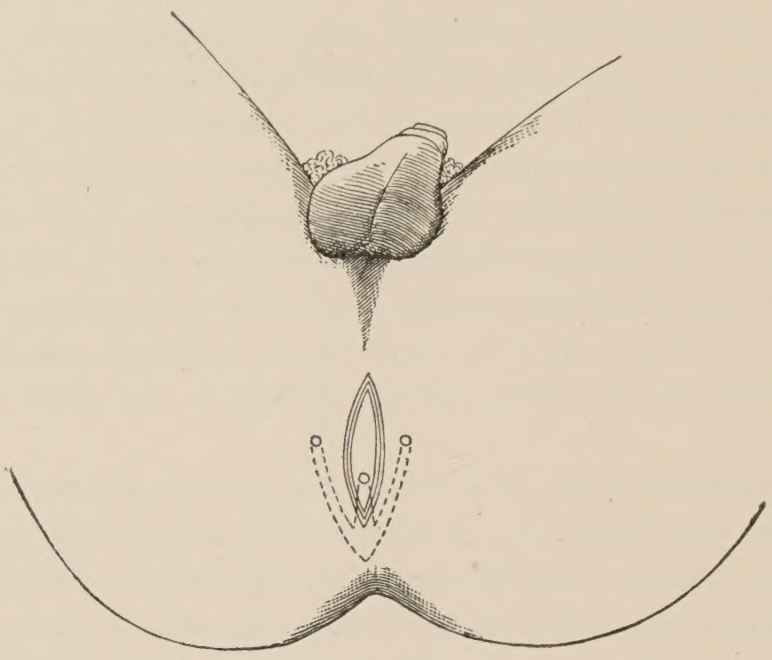
Fistulæ resulting from abscess of the ischio-rectal fossa vary greatly in extent. The track is apt to be double or branching; the internal orifice may be far below the upper limit of the disease, and the external one a considerable distance from the anus. The whole perineum and gluteal region may be found brawny and perforated with openings, sometimes as many as twenty being present, and pressure over one trochanter may cause pus to flow from an opening opposite the other.

The fistulæ resulting from deep pelvic abscesses are all of them severe, and many are incurable. The track in some of these cases has been known to lead a long distance from the origin of the disease, as in Astley Cooper's case, where there was one opening in the groin and the other near the anus, the pus having followed the course of the spermatic cord. Cases where the pus has burrowed entirely under the gluteal muscles and finally appeared in the thigh or down by the popliteal space are not very uncommon.

The term "horseshoe" fistula has been used to describe a class of

fistulæ which are not uncommon. In a general way it applies to any abscess-cavity or fistulous track which surrounds the rectum in a semicircle, either in front or behind. In a typical case such an abscess-cavity will have one opening on each side of the anus, and one into the rectum in the median line behind, but the openings may be anywhere

FIG. 66.



Fistula with Two External Openings.

or in any number, the only essential being that the pus in its burrowing has partially surrounded the gut.

After the diagnosis of the existence of fistula has once been made, there is little to be gained by careful probing before the patient is under ether at the time of operation. Such probing is painful and practically leads to little good. When the time comes to operate, it is generally early enough to decide upon the extent of the disease and upon the presence or absence of an internal orifice.

With regard to operation there are several points to be decided. Fistulæ may sometimes be cured without cutting. Small straight tracks with an external orifice may be stimulated by the application of irritants to healthy granulation, and may even close spontaneously. Applications of nitrate of silver fused on the end of a probe, injections of tincture of iodine in greater or less strength, the introduction of laminaria tents, or packing the abscess-cavity with charpie have all been effectual in some cases; but none of them can be relied upon with much confidence, and all require a good deal of time and patience.

Another question which will often be asked is whether it is safe or best to operate, and the answer to this is that it is always best to operate where a cure is possible. This question arises most frequently in connection with tubercular deposits. There is no doubt in my mind that

when the tuberculous deposit in the rectum is the primary and only one, the generalization of the disease may be prevented by an early and radical operation. Such cases, however, seldom present themselves. In general, the tuberculosis in the rectum comes after the pulmonary deposit, and here the question of the patient's powers of recuperation after the operation is all-important. It is hardly worth while to subject a patient to much of a cutting operation in the late stages of pulmonary tuberculosis, for there is very little chance that the fistula will be cured. The constant cough acts mechanically to prevent this, as well as the general condition of malnutrition, and to give any chance of cure the operation must be sufficiently thorough to destroy whatever tubercle may be deposited in the fistula. My own rule of practice, therefore, is to operate in all cases in which I believe that the patient's general and local condition admits of a fair chance of healing. Of course the patient may go on and die of his pulmonary tuberculosis, but I have never seen a case where I had reason to believe the curing of a fistula hastened this end by a single day.

There may be other reasons for not operating besides tuberculosis. The patient may be in no condition from other organic disease, and the fistulous burrowing may be palpably so extensive as to be beyond the patient's recuperative powers. Where the fistulous openings exist in great numbers, fifteen or twenty, two or three operations may be better than the attempt to cut all at once. In such cases careful examination will usually show two or three main foci of trouble with small side-tracks and diverticuli, and these may be attacked successively.

For some time I have been teaching that an operation for fistula should be done exactly as a careful dissection for one of the nerves or vessels of the perineum should be, and that a fistula is not a track with two openings through which a director is to be passed, and which when slit open will be cured. The man who operates with this latter view in mind will fail to cure all but the simplest cases.

Beginning at the cutaneous opening when there is one, the abscess-cavity or indurated track, as the case may be, is to be followed up with the knife inch by inch, no matter where it leads, till all parts are fully exposed, if the operator expects a cure; and great skill may be shown in doing this without doing more injury to the perineum than is necessary. Incontinence of fæces from division of the sphincters is a thing always to be borne in mind, and avoided if possible, and a good operator will succeed in doing this where an unskilful one will fail. In a lady, for instance, the doctor will receive no thanks for converting a comparatively painless and trifling sinus into a condition of incontinence of wind and fæces, which renders the patient unfit for society for the rest of her life.

The majority of cases of fistula, even of the bad cases, may be

cured by a skilful operator by a single division of the sphincters, and many without dividing them at all; and a single division even of both muscles, more especially if made in the median line, seldom results in incontinence. A double division of both muscles is more than likely to result in more or less permanent loss of power, and especially is this the case in women. There are cases, to be sure, in which such division is absolutely necessary for a cure, but these patients should be warned of the possibility of such a result beforehand.

Take, now, a simple case of fistula with an external opening an inch to one side of the anus, an internal one just within the sphincter, and a straight track connecting them. No operation could be simpler than the following of this track with the knife and laying it open to the sight. The lardaceous tissue composing the secreting wall of the cavity should then be scraped away, and to excite healthy repair the back wall and sides of the cavity should also be incised down to connective tissue. Much time will be saved by this free incising of the other parts of the secreting cavity after the first laying open. The wound needs scarce any dressing. A little iodoform gauze placed in the incision, and left for a couple of days, will prevent union of the lips of the incision by first intention (an accident I have known to render the operation entirely useless), and after this the wound may be left to granulate from the bottom, care only being taken to keep the edges open and to prevent the formation of fresh pockets or sinuses. The wound is treated as an open one, and only stimulated or cauterized as its appearance may indicate.

This is essentially the treatment of all cases of fistula, but the modifications are many.

In a few cases we may try to save time by securing union by first intention, not of the lips of the wound, but of the whole abscess-cavity and the incision. In the simpler cases of straight tracks without diverticula this may occasionally be done. The pyogenic membrane must first be entirely dissected out, and the parts then carefully brought into apposition—first with deep sutures of silkworm gut, and then with superficial ones. This procedure is adapted only to the simpler cases, and in these will fail oftener than it succeeds.

Supposing such a fistula as has been described to be of tubercular origin, a more radical operation is necessary. Here, after laying the whole extent of the disease open to the light, it is my practice to apply the Paquelin cautery to the entire abscess-cavity, and to trim off the overhanging bluish edges which only prevent union and have not sufficient vitality to be of any help in the healing process. The hot iron is very effectual, and yet does not burn away too deeply to accomplish the desired end.

Supposing that after commencing the dissection of a fistula at the external orifice, and following it up toward the rectum, no internal opening exists. In such a case the operator must be guided in his further steps by the amount of tissue between the end of the track and the mucous membrane. If nothing separates the gut from the abscess but mucous membrane, as can easily be decided by a finger in the bowel, the director should be forced through this slight separating wall at the highest point of the abscess-cavity and the rectal wall should be divided out through the sphincters, for the simple reason that where the burrowing has advanced as near to the cavity of the bowel as this it will, in the vast majority of cases, go on and perforate in spite of any amount of external incision; and when this has occurred the external incision will fail to cure.

Supposing, now, that an internal orifice exists, but no external one. Here the operation is manually more difficult, but the essential principle the same. A bent probe is passed into the internal opening and the general direction of the track determined. If it approaches the surface, all is well, and it may be cut open from the skin. The blind internal fistula is thus changed to a complete one, and operated upon as in the former case. In some cases it will be difficult, this manœuvre of the bent probe, and in such I have often cut boldly into the subcutaneous induration which marked the site of the abscess at first, and then found no difficulty in passing the director from the internal orifice out through the skin incision.

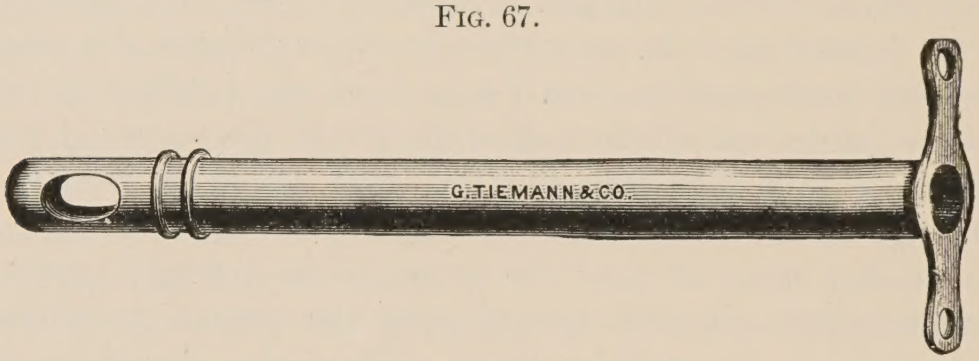
In another class of cases the probe in the internal opening will indicate that the track runs upward under the mucous membrane, and not outward into the cellular tissue. These also should be cut.

In still another class of cases the probe will enter a large abscess-cavity high up in the pelvis in the cellular tissue. These are the bad cases, and may be incurable. The abscess-cavity may be too far away from the surface to be opened in this way. In such cases under ether the opening into the gut must be enlarged with the finger or a pair of dressing-forceps, the abscess-cavity thoroughly irrigated with strong bichloride solution, and a drainage-tube left in for daily irrigation. Many will heal by a daily introduction of the finger to keep the orifice dilated and a thorough irrigation, but some will not. In women some of these may be treated by complete extirpation by abdominal section, but some of them cannot be cured. I have one now under observation in which I have already done colotomy with great benefit for a stricture of the rectum. In addition to the stricture, however, there is a large abscess in the left side of the pelvis communicating with the rectum, and the discharge from this, consisting of a couple of ounces of clear pus daily, comes up by reverse peristalsis, and is evacuated from the artificial anus. In this case I

propose to do a laparotomy for the sake of getting at the abscess and trying to induce it to heal.

Even in the more superficial cases there are some rules to be followed which increase the chances of success in operating. It will not infrequently be found that the internal orifice is not at the upper limit of the disease, but that just before the fistula perforates the bowel another track branches off in an upward direction, and extends some distance either under the mucous membrane of the rectum or in the cellular tissue outside of the rectal wall. This sinus also must be cut to ensure a successful operation. When it is merely submucous, the cutting will cause only slight hæmorrhage, for the vessels of the rectum are outside of it; but when the entire rectal wall has to be divided there may be sharp bleeding from one of the hæmorrhoidal arteries. In these operations, however, where it is proper to go with a knife it is also possible to follow with artery-forceps and ligatures, or, failing with these, the bleeding can always be controlled by a systematic packing of the rectum. For doing this a special instrument has been devised, shown in the cut. A bell-shaped sponge is tied tightly by its

FIG. 67.



Canula for Packing the Rectum.

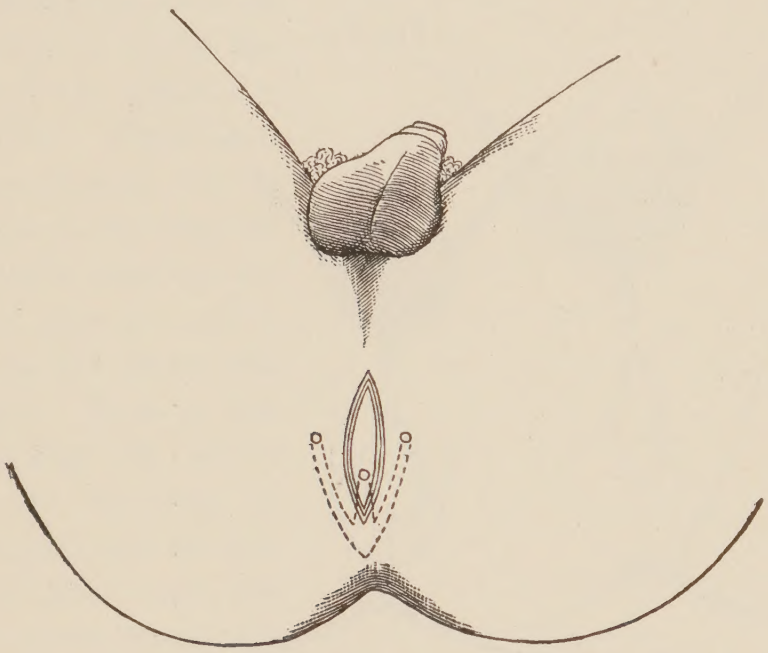
apex into the groove near the eye of the canula. This is first moistened, then dusted well with the dry subsulphate of iron, and introduced above the bleeding point. Into the cavity of the sponge dry charpie dusted with the same powder is next tightly packed, till the rectum is filled down to the sphincters. Pressure against the anus with one hand and traction on the tube with the other will pack sponge and charpie into one compressing mass which will effectually control the bleeding; the canula will allow the escape of gas and fluid fæces, and, although uncomfortable, with the aid of an occasional dose of morphine the packing may be left in a week or longer.

When the operator is afraid to cut thus freely into the upper part of the rectum, either on account of bleeding or in dread of opening the peritoneum, a long-bladed enterotome may be used to divide the tissues, or the elastic ligature may be used and left to cut its own way out; but a good operator will usually divide what it is necessary to divide with the knife, knowing always that in an emergency a posterior

division of the gut down to or beyond the coccyx will enable him readily to reach every part, and will add no risks.

Mr. Goodsall of St. Mark's has devoted much thought to the

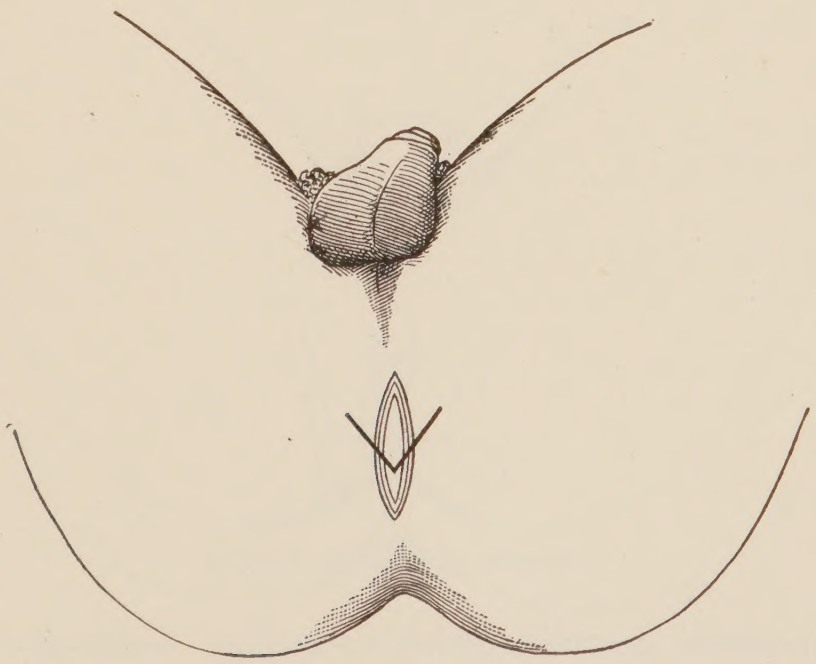
FIG. 68.



Fistula with Two External Openings.

question of operating upon complicated fistulæ without doing more damage to the sphincters than is necessary to effect a cure. In the above diagram (Fig. 68) his practice is exemplified. It represents a typical

FIG. 69.

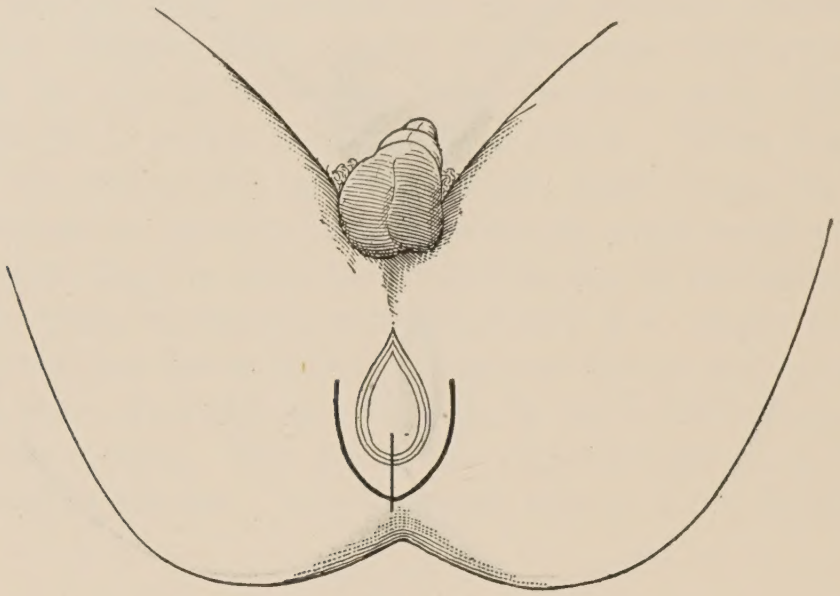


Usual Operation for Fistula shown in Fig. 66.

horseshoe fistula, with one opening on each side of the anus and a single internal orifice in the median line behind. The ordinary incisions

which would be made in such a case, and which would divide both sphincters twice and laterally, so that incontinence would almost certainly result, are shown in Fig. 69. But the track may be completely laid open by a single division in the posterior median line, as shown in Fig. 70.

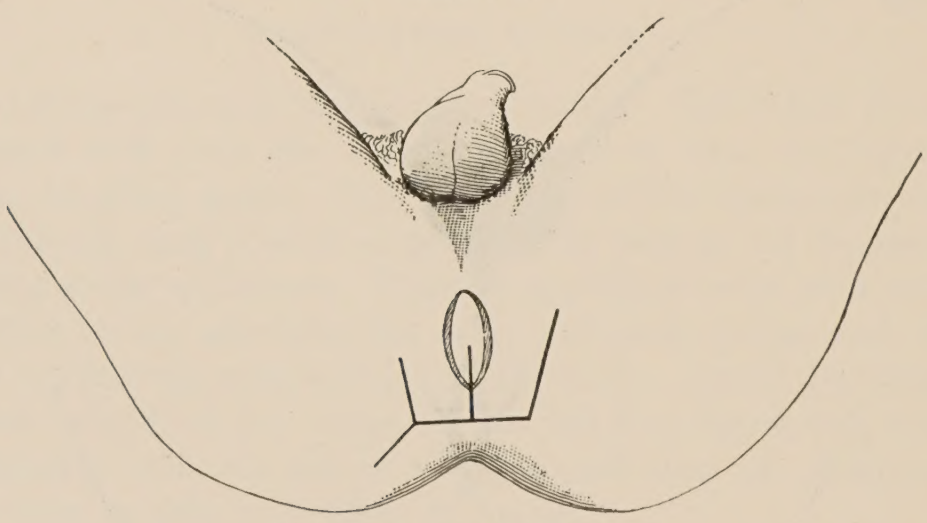
FIG. 70.



Correct Incisions for same.

A more complicated case of the same variety is shown in Fig. 71, where there are five external openings and one internal one. Imagine the destruction of the sphincters which would result from following the

FIG. 71.

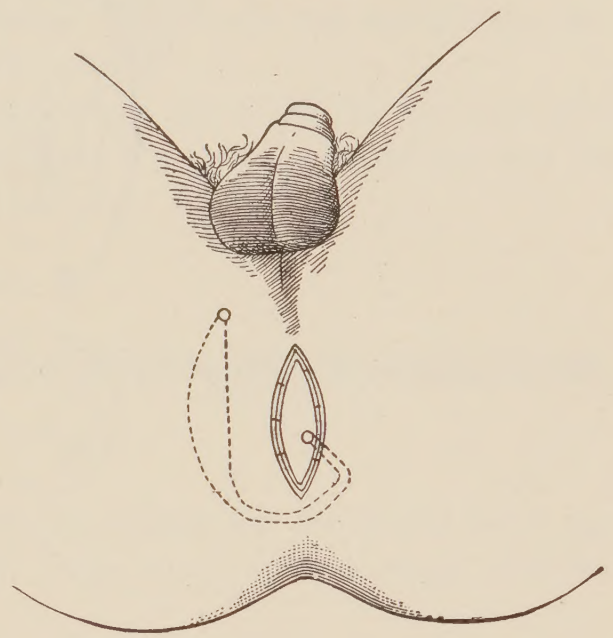


Incisions for Multiple Fistulæs.

rule of operation generally given in surgical textbooks—to pass a director from the external to the internal openings and cut upon it. The incisions by which this also can be cured are shown in Fig. 71. In Fig. 72 is shown a fistula in which to follow the usual rule would not only be almost impossible, but would result in an amputation of

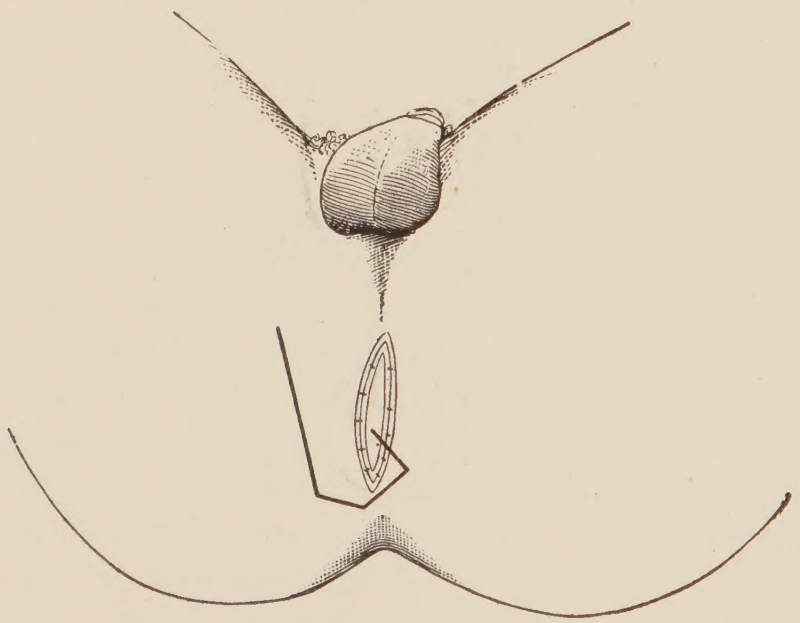
at least two inches of the bowel for three-quarters of its entire circumference. And yet the laying open of the abscess-cavity in its entire extent was a simple matter, by the cut shown in Fig. 73. This principle may be carried out in almost all operations, and yet there is one class in which the division of all the sinuses is not permissible. There is a form of this disease due to abscess of the vulvo-vaginal glands in which openings for the escape of pus are apt to form both in the labia and in the rectum. Such a case is shown in Fig. 74, where there was one opening in each labium, and two sinuses leading from these into the rectum, with cross-communications in the substance of the rectal wall. It is evident at a glance that a free division of these sinuses would mean two complete divisions of the entire perineal body, with the sphincters. In that case the cutting was done

FIG. 72.



Horseshoe Fistula.

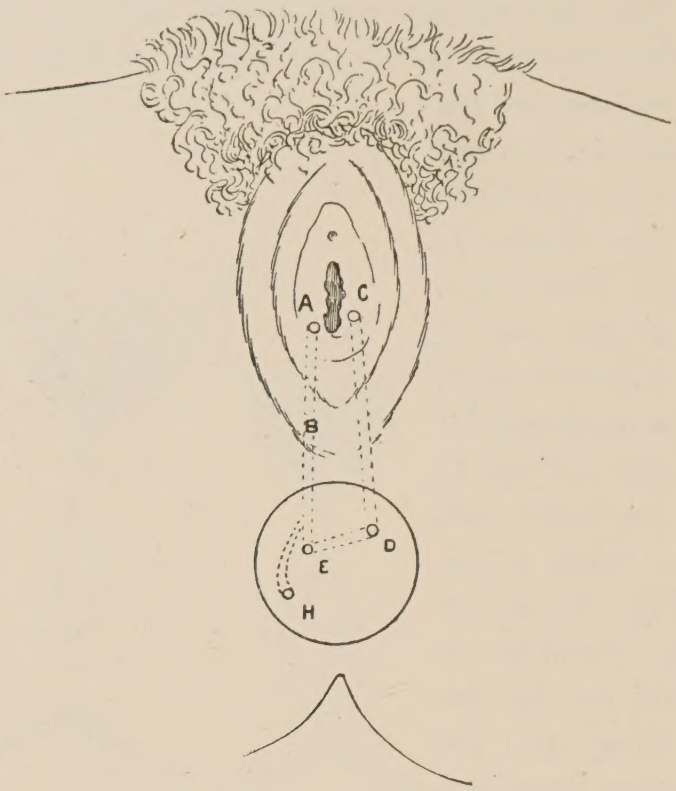
FIG. 73.



Incisions for Fig. 72.

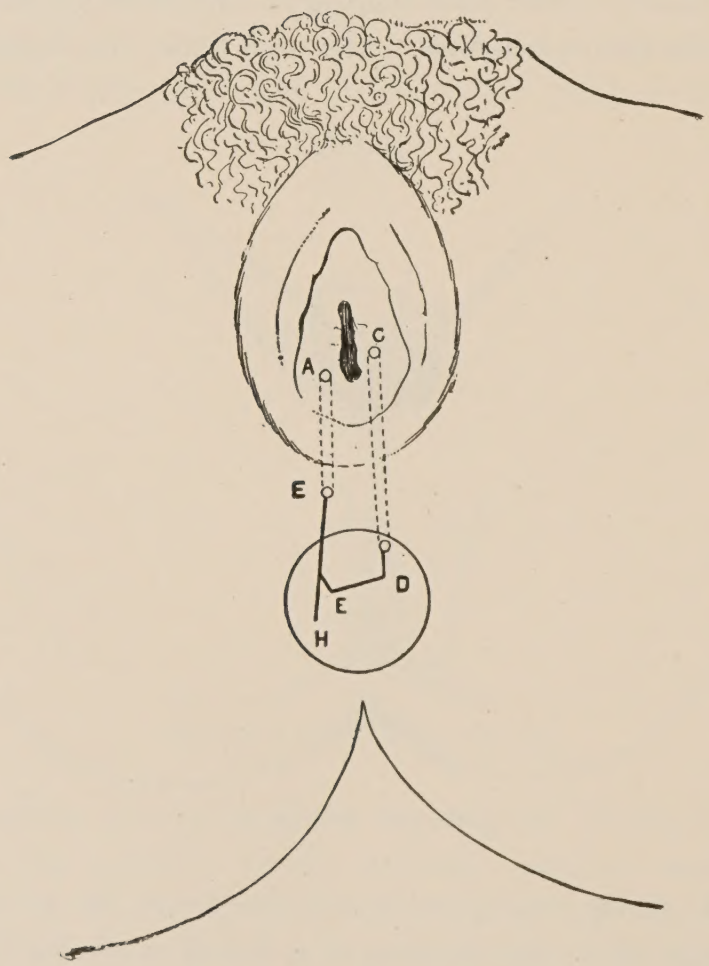
as follows: A probe was passed into the sinus at A, and forced out through the skin at B, the opening at B being made for the purpose of the operation, Fig. 75. The sinus from B to E and H was then

FIG. 74.



Recto-labial Fistulæ.

FIG. 75.

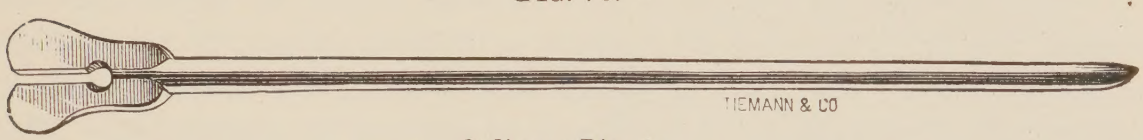


Incisions for Fig. 74.

divided, this cut involving of necessity the external sphincter, but not all of the internal. The submucous sinus E D was also divided, the opening D being just at the verge of the anus, and the incision not implicating the sphincters. Through the sinuses A B and C D setons were then passed, and allowed to remain till they had excited healthy reparative action along their tracks. The result was completely successful and there was no loss of control.

The directors used for these operations should be of steel and of a special pattern. The difference between the ones in general use and the proper ones is shown in Figs. 76 and 77.

FIG. 76.



Ordinary Director.

The cause of incontinence after operations for fistula has been the subject of considerable argument. In some cases a single incision

FIG. 77.

Proper Director for Fistulæ.

through the external sphincter has been followed by this untoward accident, while in others extensive and numerous incisions have still left the patient with good control. The explanation probably lies in two factors—one the division of the nerve-supply, which may be quite complete, by a comparatively slight incision; and the other in vicious cicatrization, by which the ends of the divided muscular fibres are not brought into apposition in healing.

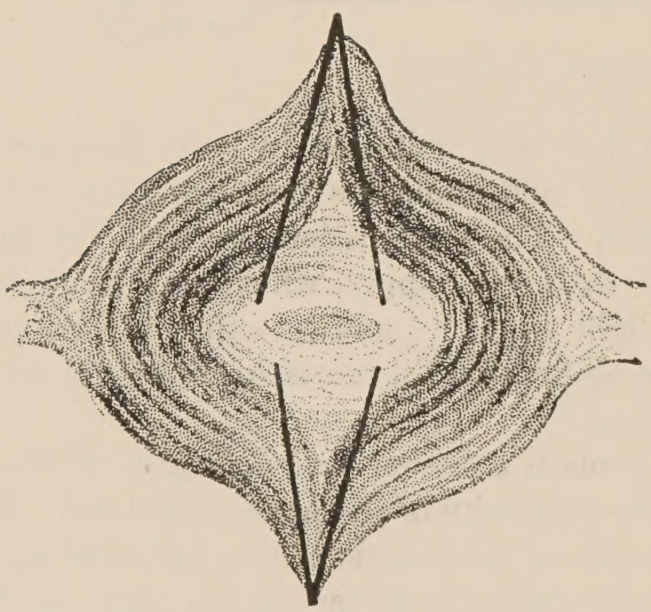
The condition is one which entails a greater or less degree of discomfort, depending mainly on the regularity of the patient's bowels. I have already spoken of this question of sphincteric action, and need not repeat it. When the patient is in the habit of having one daily solid evacuation of the bowels, he may never realize the incompetency of the sphincters. On the other hand, a patient with diarrhœa will be very miserable and unfit for society. The most grateful patient perhaps any man ever had is a lady who suffered from this, and, secondary to it, from prolapsus and a good deal of intestinal catarrh with diarrhœa, who had been confined to her house for twelve years because she could not trust herself away from the conveniences of her own home. The case was a simple one, in that the rectum had been torn into in parturition, and, though the superficial parts of the perineum had been repaired

perfectly, the ends of the sphincter had been left out. Freeing these and approximating them by a few sutures resulted in perfect control.

In the treatment of this condition the operator has abundant scope for ingenuity, and it is well to be guarded in his promises as to immediate cure. I have been successful in some interesting and important cases, but I always tell the patient that I will do what I can, and that it may be necessary to operate two or even three times. Some will be seen at a glance to be manifestly incurable—such, for example, as have no sphincter remaining, or those in which the anus has been cut over and over again till the sphincter consists merely of a number of atrophied short segments connected by dense cicatricial tissue.

The operation in a general way consists either in tightening the anus by the application of the cautery at various points, or in excision of old cicatrices and suturing the divided ends of the muscular tissue. Sometimes a combination of the two methods may be resorted to. The cautery when used is applied at three or four different points in the circumference of the anus, and deep burns are made through the sphincter down into the cellular tissue, which by their cicatricial contraction will pucker the orifice. In this way the anus may be tightened to any extent, and a combined action of all the muscles will give the patient ability to retain solid evacuations for a longer or shorter interval. Of real sphincteric action, however, there will not be very much, though the patient's condition may be vastly improved. When, however, as shown in Fig. 78, there has been faulty cicatrization, and the cicatrices can be dissected out and the ends of the muscles brought into perfect apposition, a much better result is possible, and perfect control under all circumstances may be obtained. As I have said before, there is ample room for the exercise of ingenuity and patience, but no class of cases is more satisfactory where appreciable good is accomplished.

Fig. 78.



Incisions for Fæcal Incontinence.

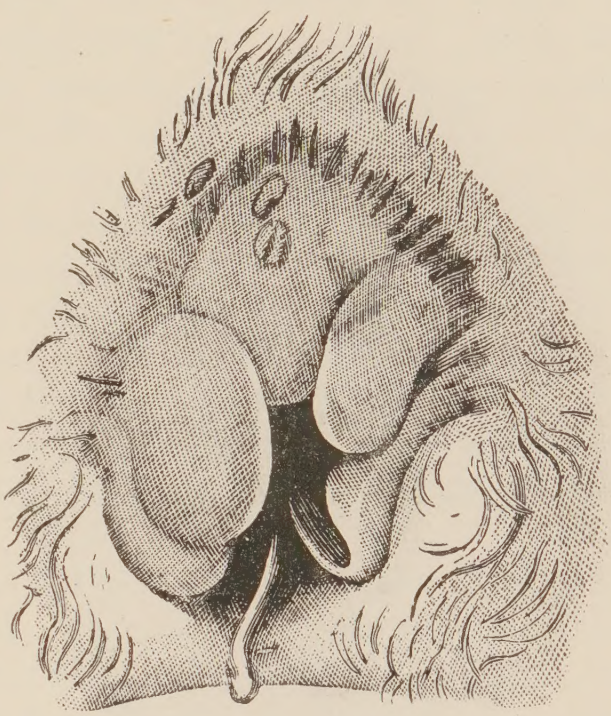
Hæmorrhoids.

For convenience it is better to divide hæmorrhoids into external and internal, and to treat of each separately.

External hæmorrhoids may be composed almost entirely of hyper-

trophied skin and connective tissue, with a free vascular supply, or of enlarged blood-vessels and extravasations of blood, without connective-tissue hypertrophy. The two varieties are totally different in their characteristics, as is shown by a glance at Figs. 79 and 80. Consider first the tag of skin and connective tissue shown in Fig. 79. This is almost always the result of some irritation, proceeding perhaps from the rectum, such as ulceration, or from the discharge from a fistula. When uninflamed it is painless, but it is liable to attacks of acute inflammation and suppuration, and sometimes small subcutaneous fistulæ may form in its substance.

Fig. 79.



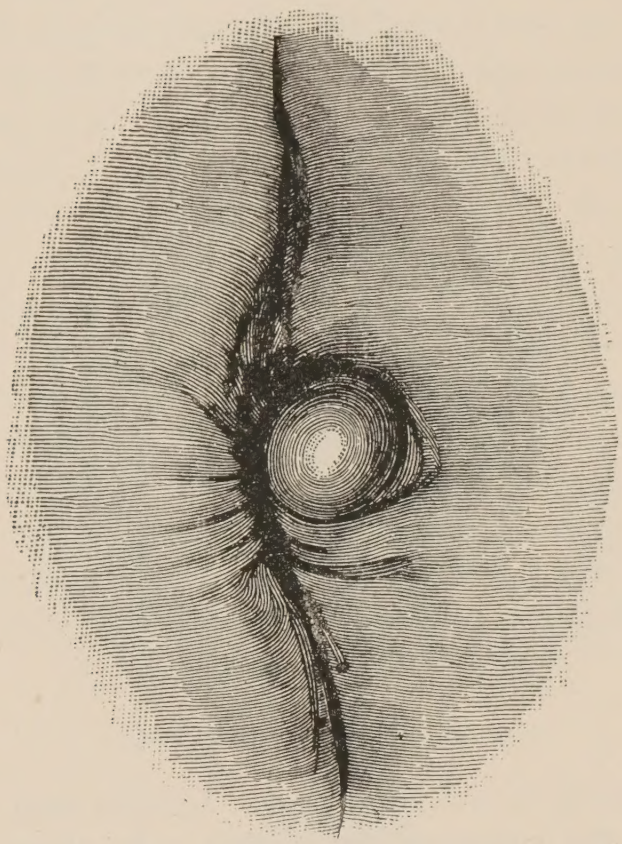
External Cutaneous Hæmorrhoids.

This form of trouble, when demanding treatment, as it seldom will except in nervous patients, is best met by simple amputation with curved scissors. The bleeding will be slight and controllable by pressure for a few minutes. Cocaine may be injected into the substance of the tumor before cutting. To those whose tendencies are toward carbolic-acid injections let me give a word of warning against their use in this and the following forms of the disease, for they will almost invariably lead to suppuration and make the patient very miserable. When these tags are acutely inflamed also, it will generally be found to save trouble to amputate them rather than to incise them.

The second form of external hæmorrhoids is an extravasation of venous blood into the delicate connective tissue of the margin of the anus. Instead of a tag of skin there is a round, exquisitely sensitive, venous tumor, showing plainly the dark mass of clotted blood through the stretched and delicate covering. Such a tumor may come on quite suddenly after straining at stool or a night's debauch. At first it causes uneasiness, then pain. The patient vainly endeavors to relieve himself by pressing it up into the rectum, and, though pressure for the moment accomplishes this, the tumor reappears at once. After days of discomfort such a tumor will either shrivel up and leave a small tag of the first variety, or the clot will break down and suppurate; there will be a slight discharge of pus and almost instant relief.

In sensible persons the suffering caused by this condition can be instantly relieved by passing a fine, sharp bistoury through the tumor and turning out the clot. This is about the only operation in surgery I ever perform without the patient's consent. Otherwise, the sufferer must be put to bed, the liver freely acted upon by podophyllin, and the painful little tumor treated either with ice or hot poultices as may seem to give the most relief.

FIG. 80.



External Venous Hæmorrhoids.

There is a form of internal hæmorrhoid which stands alone. It is the slightly raised collection of arteries and veins which strongly resembles a nævus. It never forms much of a tumor, nor is it apt to occasion pain, but it bleeds on the least provocation, and sometimes nearly exsanguinates the patient. A movement of the bowels is enough to start the flow, and then, if an examination be made, the blood will be seen issuing in a jet from what seems to be only an eroded surface the size of a finger-nail. This form of disease is also readily cured, and, to the patient's delight, it can always be done "without operation." With a speculum in the rectum the spot is first dried with a pledget of cotton, and then thoroughly painted with fuming nitric acid on the end of a match. One such application well made will suffice for a radical cure; and this, by the way, is the only form of hæmorrhoid in which applications of nitric acid are likely to do much good, although at one time this form of treatment enjoyed a good deal of popularity.

Coming now to internal hæmorrhoids proper, we find them made up of masses of enlarged veins and connective tissue, forming distinct tumors springing from the rectal wall just above the external sphincter. When uninflamed and not eroded or ulcerated, they cause little pain, but they prolapse at stool, are sometimes difficult to replace, bleed more or less freely, and may excite an exaggerated train of reflex symptoms in any part of the body connected by its nerve-supply with the sacral plexus.

In the treatment of this condition there are several points to be considered. First, as regards palliation. Many sufferers will not

submit to a radical cure, and for them it is possible to do something by simple means, though perhaps without much satisfaction. Patients with hæmorrhoids should be careful as to diet and avoid alcohol, which either by its irritation of the alimentary canal or its action in causing congestion of the liver has an immediate bad effect. When a patient comes for treatment with a history of late excesses, the first thing to be done is to unload the portal circulation by active catharsis. Next, the tumors may be treated by certain local applications. The best astringent is cold water freely applied to the parts after defecation every day. In addition to this a suppository or an ointment of subsulphate of iron may be either smeared over the tumors when prolapsed or introduced into the rectum. This will sometimes in great measure control the bleeding. Perfect regularity in the evacuations must also be secured; and when these measures have been carried out, about all has been done that can be done without radical operation.

Occasionally there arises a condition of complete or partial strangulation which requires a word. The patient with large tumors finds, to his surprise, that they have come down and cannot be replaced as usual. After bruising them for a time in the attempt he leaves them to go up of themselves, and goes about his duties. Soon they become painful and swollen, and after a few more attempts at reduction he sends for a doctor. By this time the tumors may have become partially gangrenous.

Here also we have two plans of treatment to choose from. My first attempt is always directed toward taking advantage of the patient's extremity and getting him to submit to a radical operation. The condition of the parts is not a contraindication to operation, though care must be exercised as to the amount of tissue to be removed. Failing in this, the first thing is to accomplish reduction if possible. With the patient on his face in bed and the buttocks raised upon pillows, the tumors are first greased with sweet oil. Taxis should then be employed as in hernia, the last part down being the first to be put back. It is better to confine the effort to one part of the mass, for if this will go up the rest will follow. Taking, then, some one prominent point on the ends of the first two fingers, gentle continuous pressure is made, and as the part disappears within the anus the fingers follow it well up into the rectum. If this can be done, the remainder can generally be reduced, section by section, in the same way.

Should this fail, give the patient a sufficient quantity of ether or chloroform to produce primary anæsthesia, and dilate the sphincter till the mass can be reduced. If this is refused—and it sometimes will be—leave the man in bed, give a cathartic, put ice or hot poultices on the parts, and in a week or so they will subside. If sloughing occur, it will go far to effect a radical cure.

In a work of this nature it is manifestly impossible to consider all of the possible ways of radically curing hæmorrhoids, and it will suffice for our purpose merely to describe those most generally found reliable. Of these there are two which will always cure with very little danger, and which have given entire satisfaction for many years; and every practitioner will choose for himself between the ligature and the clamp.

The operation with the ligature owes its deserved popularity to the influence and practice of the elder Allingham at St. Marks. Briefly described, it consists in dissecting off the pile from the muscular tissue with the scissors till its upper part is reached, where its chief blood-supply is received, and in tightly tying the remaining pedicle with a strong ligature, both pile and ligature being then cut short.

This is an operation as safe and as certain of cure as any in surgery. It is quickly and easily performed, is little likely to be followed by accidents, has scarce any mortality, and is in every respect satisfactory. The objections to it are that it sometimes causes a good deal of after-pain—pain which I have accounted for by the ligature of nerve-filaments in the pedicle.

In striving to find some equally satisfactory and safe method of radically curing this disease I was led to experiment with another operation, also sanctioned by good authority, and which I hoped might not be attended by the same amount of after-pain as the ligature. In the operation with the clamp and cautery I believe I have found it, but this is all that I claim for this operation over the ligature. Did I not use the clamp, I should always use the ligature, and by either method every case of piles may be cured where any operative procedure in indicated.

My own operation with the clamp and cautery I adopted on the recommendation of Henry Smith of London. I claim no originality in it, except as every operation will be slightly modified in technique by the individual operator; but I do believe that by it a radical cure can be effected as safely (and no more so) as by the ligature, and more especially that my patients suffer less during convalescence than do those operated upon by the ligature. This I am in the habit of accounting for by the fact that no nerve is tied up in a string—that sensibility in the pedicle of the tumor removed is in great part destroyed by the application of the actual cautery. I believe also that there is less reflex irritation, that the catheter has less frequently to be used, and that my patients are altogether more comfortable than those operated upon by the ligature.

Of course pain is more or less relative, and in the settlement of such questions as these large numbers of cases must be compared. I do not wish to convey the idea that the operation performed by myself is painless, for occasionally a nervous patient will complain a good deal

of pain for several hours; but it is an unusual thing in my own practice to give any morphine after the operation or to have to resort to the catheter. It is not long since I operated upon an active business-man in the afternoon, and in the early evening found him sitting up in bed presiding at a directors' meeting, having eaten a good dinner, and smoking a cigar. My students at the Post-Graduate Medical School are not at all surprised to see these patients dress and come down stairs to show themselves to the class forty-eight hours after the operation. I never refuse to allow a patient to dress himself and be about his room on the second day, and most of them prefer to do so. This is all the advantage that I claim for the cautery over the clamp, and this claim I believe to be well founded.

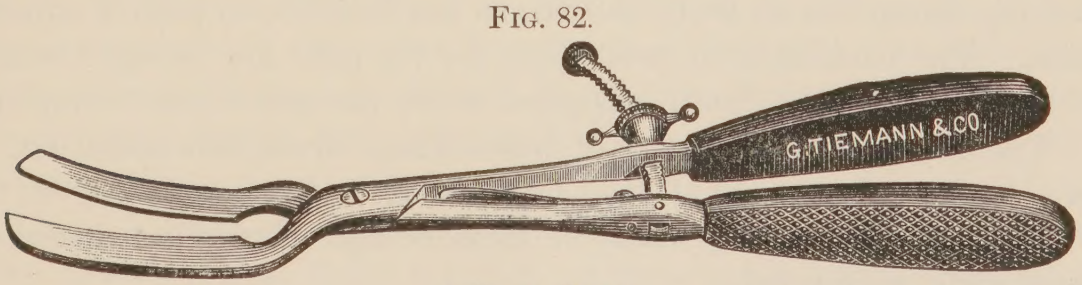
I find that no verbal description will teach all men how to perform this operation, which is one of the simplest, and I must confess to never having seen anybody else perform it except under my personal supervision. Very early in my experience I modified the clamp of Smith to suit my own ideas, and abandoned entirely his different forms of cautery-irons for a simple medium-sized point of the Paquelin cautery. There are but four instruments necessary for the operation—the clamp, cautery, a long pair of scissors, and long double-pointed forceps after the general pattern shown in the cut.

FIG. 81.

Forceps for Hæmorrhoids.

The sphincter is first sufficiently dilated to allow of bringing down the piles outside of the anus with the forceps. If the tumor involves the margin of the anus, and if it is desirable to remove a portion of the skin of the anus with the pile, a groove is made in the skin with

FIG. 82.



Author's Clamp.

the scissors, otherwise they are not used. In the groove thus made the clamp (Fig. 82) is applied, the tumor to be removed being drawn well downward by the forceps. This groove answers exactly the same

purpose as the cut made by Allingham for the ligature. It prevents the burning or crushing of healthy skin, exactly as it avoids including it in the ligature. With the clamp in position the mass of the tumor to be removed is cut off with the scissors, care being taken to leave a good substantial stump outside of the bite of the clamp for the application of the cautery. During this cutting the clamp acts merely as a temporary ligature to prevent bleeding. It is not at all a crushing instrument, and has only sufficient force to prevent the pedicle from slipping out of reach, and to control all hæmorrhage while in position. The cautery is then applied freely to the stump left by the scissors, till it has been burned down even with the surface of the clamp. The object of the cautery is simply to prevent bleeding after the clamp is removed. It is well to relax the clamp slowly, and see if the cauterization has been sufficient for this purpose. If no bleeding point appears, the clamp may be entirely removed and the burned stump allowed to slip up into the rectum. Should any vessel not be closed, the clamp, being still in position, is immediately tightened and the cautery applied again. It will be seen by the cut that the instrument is provided with a screw for keeping the blades closed. This may be useful, but in ordinary cases is of no value. The instrument is controlled entirely by the left hand, the handles being made long and strong for this purpose.

There are several points which I find need special attention in this operation. I found not long since that they were practising it in Toronto with results not at all satisfactory. There were great pain, inflammation, and some sloughing after the operation. I had occasion to operate on one of the medical gentlemen of that city, and could only persuade him to submit to it with difficulty. After convalescence the difference between his own case and those he had seen was so great that he determined to see me operate on somebody else, and the reasons for the difference became manifest. In the operations he had seen the clamp had been passed into the rectum parallel with its axis, and the cautery had been passed up after it to do its work. It will be seen that my clamp has no ivory shields, as has Smith's, to protect adjacent parts. The parts need no protection, for the piles are brought outside of the anus, and the clamp is applied across the orifice, not within it.

There is said to be danger of hæmorrhage from this operation. I have known of one case of fatal hæmorrhage a few hours after it, but I have known of many cases of hæmorrhage after other operations improperly performed.

The application of the hot iron to a bleeding surface is still considered a good hæmostatic in suitable cases; why not in the rectum? And yet I can easily see how an unskilful operator may have bleeding after this method. It will be seen that my clamp does not shut parallel,

and when a large mass of tissue is in the heel there will be very little pressure upon that in the grasp of the end. Cutting off such a large mass will sometimes allow of some escape of the stump from the point of the instrument. That which remains is cauterized; there is a spouting vessel in the end of the cut that has escaped the cautery, and bleeding results. If the clamp is put on with the heel up the rectum and the point at the cutaneous margin of the pile, the bleeding point must be at the surface. If put on in the reverse direction, which is a little easier, the bleeding point will be high up in the bowel.

The only answer to this is that leaving a spouting vessel in the stump without applying the cautery to it is not the clamp-and-cautery operation, and is a decidedly reckless and unsafe piece of surgery.

I have great faith in these eschars myself to prevent bleeding—so great that after every operation I introduce a large speculum, dilate the bowel, and irrigate it thoroughly with bichloride solution. If there is any bleeding, I see it and go back after it, and I teach my students never to leave such a rectum till they are sure there is no bleeding from within it. The cutaneous incisions with the scissors will bleed some, and this is controlled by pad and bandage.

One other point to be guarded against: this operation is capable of producing a stricture of the anus. So is the ligature or any other where tissue is removed. The clamp should not be recklessly applied to the entire circumference of the anus, but small intervals of sound mucous membrane should be left at least at two opposite points. The operation is applicable to the most severe cases, and sufficient tissue can always be removed to cure without causing undue contraction if proper care be used. Should stricture result, it is not a very serious affair, and is very easily cured by proper dilatation.

After the operation a pad of lint and a T bandage are tightly applied. In a couple of hours these may be removed, and a poultice substituted, which will relieve the pain. I make no attempt to confine the bowels after operation, and give a laxative at the end of forty-eight hours to secure a passage. With average rest and quiet cicatrization will be complete in about three weeks. During the first week I try to keep my patients in the house, but afterward they attend to their usual duties, unless this requires them to be much on their feet, in which case I insist upon longer rest and watch the healing process much more carefully.

There is little more to be said. The dangers of this method can easily be seen and as easily avoided. I have never had an unpleasant experience with it, but no operation is perfectly safe in unskilful hands. Sometimes, when the sloughs separate, I may have a fatal case of secondary hæmorrhage, and so may anybody else with the ligature about the tenth day, when it comes away. I spoke of one fatal case

of primary hæmorrhage, and that this may not have undue weight against my favorite method I will mention that not long ago there was a death in one of our largest and best hospitals from the same cause—after the ligature. Neither is to be laid to the operation—both to the operators.

So much interest is felt by many in the method of treating hæmorrhoids by injections of carbolic acid or other substances that it may be best to devote a few words to it before closing the consideration of this subject.

The method is well understood by the profession at large, and it has its advantages, which, however, are more than counterbalanced by its risks. The advantages are, that, by what seems to the patient a trifling and, for the moment, painless puncture of a needle, his piles may be greatly relieved. The disadvantages are that the injection of an irritant fluid into the substance of a vascular tumor is liable to set up a good deal of trouble. The remedy is too uncertain in its results to be recommended. Many cases are quite satisfactory. There is apt to be a good deal of pain following the injection, coming on in the course of a few hours and lasting some days; but the mild amount of inflammation thus set up results in hardening and shrinking of the tumor, so that for a time it neither bleeds nor protrudes. The relief thus obtained may last two or three years, after which the condition will be the same as before.

If this amount of palliation could be secured without risk to the patient, the treatment would be a most excellent one; but, unfortunately, such is not the case. Great pain often succeeds the injections—pain sufficient to confine the patient in bed and render necessary large doses of opium. In many cases the injection will cause a slough, and when the slough separates there may be severe hæmorrhage, and a ragged ulcer remains, requiring careful treatment for its cure. If the slough be circumscribed, the patient is apt to be cured of that particular hæmorrhoid; but there is often burrowing, and a class of blind fistulæ with internal openings results which cannot be cured without operation.

In many cases small marginal abscesses result. These, in my experience, have not been larger than the end of the thumb, have always been just at the margin of the anus on the same side as the pile injected, and unless freely opened have made small subcutaneous fistulæ. They are not situated at the point of puncture, but lower down.

Finally, when an inflammation is started in the walls of the rectum, no man can limit its extent, and either a circumscribed or general periproctitis may be the result. Large abscesses may form, the patient has the usual signs of septic poisoning, the lymphatics in the pelvis and groin

become involved, and if the patient's life is saved, it is only by good luck and bold surgery.

All these accidents have occurred after injections made by myself, and others have reported fatal results. For these reasons I have practically abandoned the treatment, and yet it has its fascinations. Not long since a woman came to my clinic complaining of the loss of blood from the rectum. She was just at the end of the third month of pregnancy, and was covered with an early syphilitic eruption. It was impossible to operate on her hæmorrhoids, and for the sake of showing the class how it was done I made three injections of a 10 per cent. solution of carbolic acid at intervals into three tumors. The result was perfectly satisfactory, the woman believing herself cured. This may be done in a number of cases, and just as confidence is established in the mind of the practitioner, and for no reason that can be foreseen, an injection of moderate strength will set up some of the accidents I have enumerated. I believe that my personal experience with this method, over which I was at one time very enthusiastic, is not different from that of others who have given it a fair trial in any considerable number of cases, either in hospital or private practice. I know that it coincides very accurately with the results at St. Mark's, where its use has also been abandoned.

Prolapse and Invagination.

The simplest form of prolapse is that which is composed only of the mucous membrane of the rectum. It is also the form most commonly seen, and to a slight extent is often found in connection with old and large hæmorrhoids. It is said to be more frequent in women than in men, and it is the form usually seen in children.

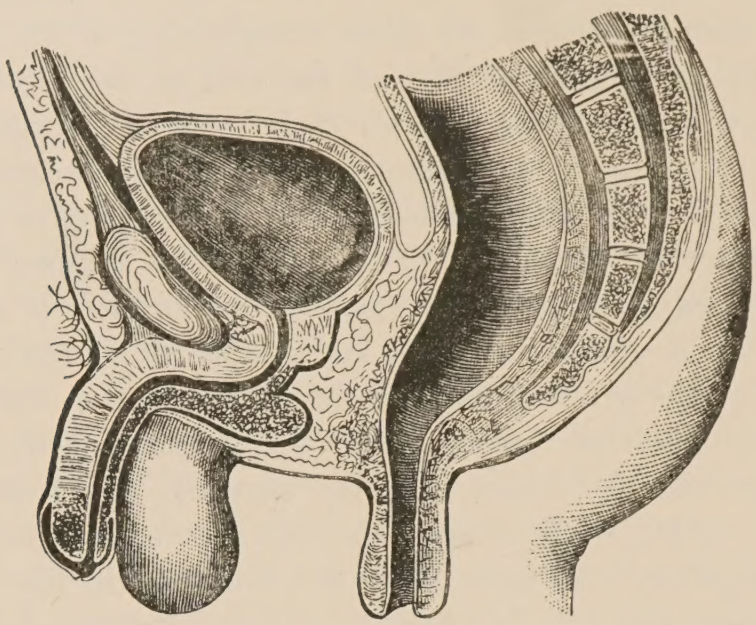
The second variety of prolapse is an exaggeration of the first. It consists not in a sliding down of the mucous membrane, but in an inversion of all the coats of the bowel, and therefore, when of sufficient extent, of the peritoneum. The first variety is shown in Fig. 83, and the second in Fig. 84. In both these varieties the protrusion begins at the part of the rectum nearest the anus. In the third variety the part of the rectum higher up is passed into and through that nearest the anus, and what is known as invagination or intussusception takes place. In the fourth variety we have the same condition as in the last, except that a portion of the gut farther away from the anus is implicated, and the invaginated portion may not appear at the anus at all. We may have, therefore, invagination with prolapsus or invagination without prolapsus.

This condition must, of necessity, cause a sulcus or groove to exist between the containing and contained portions, where the mucous membrane of the one is directly continuous with that of the other, and the

depth of this sulcus from the anus depends upon the point at which the invagination has occurred.

Such a protrusion as this is evidently composed of an entering and

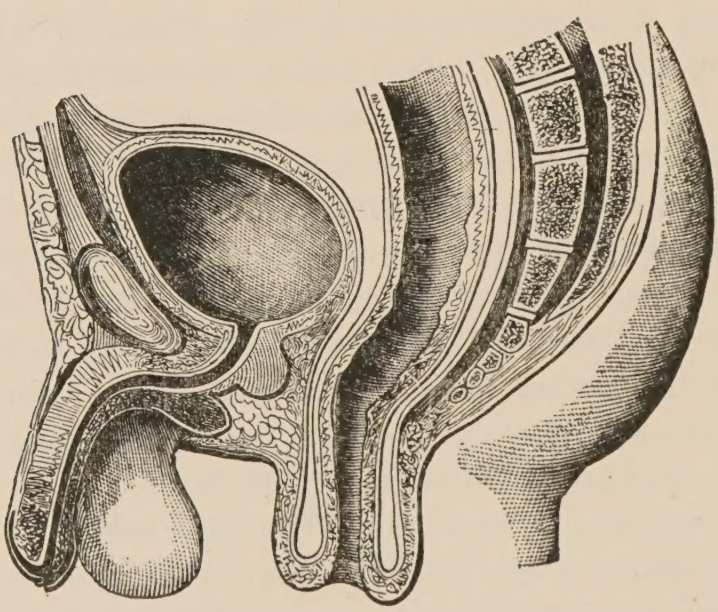
FIG. 83.



First Variety of Prolapse.

returning portion of bowel, each in its whole thickness (Fig. 85). There is the ensheathing portion, *1*; the entering portion, *3*; the returning portion, *2*; which must be carefully distinguished from

FIG. 84.



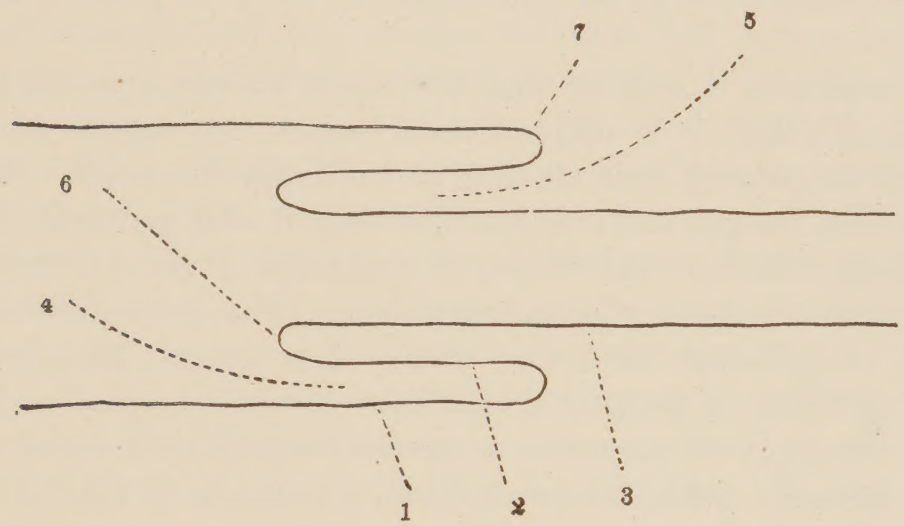
Second Variety of Prolapse.

each other. The former (*1*) is sometimes spoken of as the intussuscipiens, and the two others combined as the intussusceptum. Within the sulcus (*4*) two mucous surfaces are in contact, and without the sulcus (*5*) two serous surfaces. The point (*6*) where the entering portion

(*3*) becomes the returning portion (*2*) is known as the apex of the intussusception, and the point (*7*) where the returning portion joins the sheath is the neck.

The causes tending to produce a prolapse are various: First, those

FIG. 85.



Intussusception.

which tend mechanically to draw down the mucous membrane in defecation, such as polypus, hæmorrhoids, vegetations, and tumors. Second, are those which produce tenesmus and muscular spasm, such as fissure, worms, proctitis, dysentery, phimosis, cystitis, calculus, and stricture of the urethra. Third, are those which tend to weaken or destroy the action of the sphincters, such as ulceration or incision or spinal paralysis.

Prolapsus of the first and second varieties generally comes on gradually, and not suddenly, though the reverse may be the case. It may be partial or complete as regards the circumference of the rectum. It is at first spontaneously reducible, or at least easily replaced by gentle pressure, and it remains reduced till the next act of defecation; but as the size of the prolapse increases the difficulty of reduction becomes greater.

Prolapsus of the first variety when slight in extent is not infrequently mistaken for hæmorrhoids at a casual examination, especially when it is confined to a portion of the circumference of the gut. With care, however, a protrusion composed of healthy or slightly eroded mucous membrane can always be distinguished from a tumor made of blood-vessels and connective tissue located beneath the mucous membrane. When the tumor is larger the diagnosis presents no difficulties.

In every prolapse of large dimensions the surgeon must be prepared to find all of the coats of the gut involved, and hence must be on the lookout for the peritoneum. From the anatomy of the peritoneum it is much more likely to be found in the anterior portion of the tumor

than in the posterior, but it may be in both. In the peritoneal pouch thus formed there may be located coils of small intestine, an ovary, or even the uterus, as will be more fully described later. As this variety of the disease only differs from the first in degree, there is no groove or sulcus, as in that next to be described, and the absence of such a groove is therefore no proof against the presence of peritoneum in the tumor.

It is a mistake to suppose that this second variety is not met with in children, although it is unquestionably more common in adults. It may be distinguished from the first generally by the touch. With one finger within the gut and the thumb outside it will generally be possible to decide whether the tumor is composed of all the walls of the bowels or of the mucous membrane alone. The form of the tumor is conical; its walls are thick and firm; when pressed between the fingers the gurgling of gas may be felt in a contained loop of small intestine, or there may be resonance on percussion, and the hernial contents may be reduced; the orifice is not round and patulous, but slit-like and drawn backward by the attachment of the meso-rectum or forward by the vagina.

A prolapse left untreated usually increases. At first it only appears on defecation; later it is down all the time. At first it is easily reducible; then a change occurs, and replacement is no longer possible. When inflammation occurs there is more or less local irritation and general constitutional disturbance. The prolapse becomes swollen, hard, and painful, and the tumor is subsequently larger and harder than before, from infiltration. The mucous membrane may at any time become eroded and ulcerated from irritation. Strangulation is rare, but may occur at any time. It may be only temporary when properly treated, or it may end in sloughing, which shall involve a part or he whole of the tumor. It may result in cure from cicatricial contraction, or in general peritonitis and death. When it involves the entire circumference of the tumor, a stricture of greater or less gravity is the necessary result. These changes are not apt to occur in the first variety of the disease, and are generally confined to the second and third.

The treatment of prolapsus of the first and second varieties may be either curative or palliative. Often the surgeon's first efforts must be directed toward effecting the reduction of the mass. In children this may generally be done by laying the little patient on its face over the knees, and making gentle pressure on the mass with greased fingers. If this cannot be accomplished without undue force and bruising of the mass, the child should at once be etherized and a radical operation performed.

In an adult, however, both ether and operation may be either

refused, or, on account of a bad general condition, contraindicated. In such a case, after gentle taxis in the knee-elbow position has been tried and failed, cold should be applied while the patient remains prone in bed with the pelvis raised by pillows, and this may be alternated with warm poultices and with plentiful applications of an ointment of opium and belladonna. When by the action of the sphincters the tumor has become œdematous, cold is especially indicated, but it must not be too long or vigorously applied, lest sloughing result. When sloughs have already appeared, the case must be left to time and charcoal poultices, and, unless the sloughing be very extensive or circular in shape, a radical cure will often result after about three weeks' rest in bed.

Before any kind of treatment except reduction is begun the surgeon must carefully seek for some exciting cause, the removal of which will effect an immediate cure. Polypus is the most frequent and efficient of these, and many a case of extensive prolapsus in children may be cured by passing the finger into the bowels and breaking off a small fleshy tumor hanging loose by a long slender stem. Worms, constipation, phimosis, and calculus should all be looked for and treated before any operation is done upon a prolapsus dependent upon their irritation.

The palliative treatment is directed toward diminishing the frequency and amount of the prolapse, and in children a cure may sometimes be effected by these means alone. The tumor may sometimes be prevented from descending during defecation by having the act performed in the standing posture, or recumbent in bed with one buttock pulled aside to tighten the anal orifice. After the bowels have moved, if the tumor has come down, it should be washed with an astringent (alum, tincture of iron, oak bark) and gently replaced, the patient being confined to the bed for a time to prevent re-descent. After the bowel has ceased to descend with defecation, an astringent injection may be given every night with advantage, and allowed to remain in all night. This should not be more than a couple of ounces.

After inflammation or partial strangulation has occurred, a cure by these simple measures is scarcely to be expected. The conditions are changed; the tumor is thickened and increased in hardness; it has become too large for its former relations in the pelvis, and is itself a cause of irritation.

There are two ways of curing a prolapse: one is the reduction in the size of the tumor or its complete removal; the other is the tightening of the anus, so that it cannot descend. In any case one or both of these methods may be attempted.

Attempts, and some of them successful in severe cases, have been made to cause a decrease in the size of the tumor by injecting certain irritating substances into the tumor itself and the surrounding cellular

tissue. The plan is one which has never acquired much popularity except in the slight cases associated with hæmorrhoids, in which, when the latter have been reduced in size by injections of carbolic acid, the prolapsus dependent upon them has also ceased to be troublesome.

The first form of prolapsus may be cured by one of the three following methods: When not too large or too much thickened, a thorough painting of the mucous membrane with strong nitric acid will generally cause just sufficient sloughing to result in a cure. The application must be made when the tumor is down. The part should first be dried of its mucus with a little cotton, and the acid then applied lightly on the end of a stick. Only enough should be put on to cause a distinct change in color, and the acid should very carefully be confined to the mucous membrane, and not applied to the skin. The application is not in itself painful. The tumor should then be greased and reduced, a pad should be placed over the anus, and the buttocks drawn together with a broad strip of adhesive plaster. The bowels should not be allowed to move for three days, and then an enema of oil should be given, and great care taken to prevent the descent of the tumor, as before indicated. It may be necessary to repeat the use of the acid a second time, but it will generally be efficient in the end. This plan is especially adapted to children, in whom there is apt to be a good sphincter.

In old people, where the sphincters have lost some of their power, and in children who have resisted this method, another plan of cauterization will be more effectual. This is known as Van Buren's treatment, and is performed as follows: With the patient under ether and the prolapse down, the smallest tip of the Paquelin cautery, heated only to a dull red, is drawn over the length of the tumor with just sufficient force to go through the mucous membrane. Five or six linear eschars should be made, very lightly at the upper portion, heavier below. The tumor should then be replaced, and the sphincter burned at two points on opposite sides with the same iron; but these cuts should be made into the substance of the muscle, so that the resulting contraction will lessen the size of the anus. After the cauterization the patient should be treated as after the application of the nitric acid.

In more severe cases still, and in cases of the second form of the disease in which there is no reason to fear the presence of peritoneum a still more radical operation may be done. This is exactly the same clamp-and-cautery operation described in speaking of hæmorrhoids, and it is equally satisfactory. It has been applied in years gone by to very large tumors containing peritoneum—tumors the size of a cocoanut—and with good results; but now we have a better way of dealing with all the cases in which, from their size, the presence of the

peritoneum is to be apprehended, as well as those old and severe ones sometimes met with which have resisted all other methods of cure.

The operation of circular amputation and suture has been applied occasionally to old cases of prolapse for some years, and within the last year or two has become quite general. It is done in several different ways, but the essential idea is the same in all. It consists in first making sure that the prolapsus contains no hernial contents, then in amputating it below the anus—first the anterior half, and then the posterior—and, finally, in carefully suturing first the serous surfaces if they are present, and secondly the other layers of the gut. I have found it an advantage to transfix the tumor after it has been well pulled down by two long needles, passed so as to cross each other through the entire thickness of the prolapsus just below the sphincters, and then to encircle the mass with an elastic ligature above the needles, which prevent it from slipping. This does not at all interfere with the operation, and effectually controls the bleeding, which is apt to be profuse when the gut is amputated. Of course the greatest care is necessary in an operation such as this to be sure that the amputated mass does not contain a loop of small intestine. The results of this method seem to be exceedingly good, and when done properly the plan is to be recommended in cases in which milder methods have failed.

The surgeon will occasionally be called to treat a case of quite extensive prolapse in which there is a circular slough, and must know what to do in such an emergency. It is not best to leave these cases to nature, for though the slough will separate and the tumor shrink up and finally become reducible, the slough will leave a circular stricture, and the lower down, nearer the apex of the prolapse, the slough is, the higher up and less amenable to subsequent treatment the stricture will be. In all such cases the operation of circular amputation and suture is to be recommended. Even should the amputation be followed by some contraction, the stricture will be low down near the sphincter, and can easily be treated by subsequent dilatation.

Every few months a case is reported in some journal of so-called "spontaneous rupture of the rectum" or of "rectal hernia," with protrusion of a mass of small intestine, and death. Almost invariably, the history begins with the statement that the patient had suffered for years from prolapse. These cases almost all come under the second class described, and are cases of rupture of weakened and inflamed prolapsus, usually either from direct violence or from straining at stool, although a weakened rectum may rupture and permit of the escape of small intestine where there has been no previous prolapsus. It is doubtful whether a healthy rectum is ever ruptured except as a result of direct injury.

In my work on *The Rectum and Anus* I have collected all of these

cases obtainable, some twelve in number, and have analyzed them. For lack of space the reader is referred to that work for a full account of the disease. Here I wish only to call attention to the treatment. Only two of these cases have recovered. One was a very early one (Nedham, 1755), in which, after the protruding mass, measuring fifty-seven inches, had become gangrenous, it was simply cut off close to the anus. The other is one in which the hernia of the small intestine followed an operation by Henry Smith on a large prolapsus with the clamp and cautery. Only a knuckle of the gut protruded, was at once reduced, and no bad symptoms followed.

The general principles which should guide in the treatment of this accident are plain, and I am anxiously waiting the report of the first fortunate case in which their adoption will be followed by a cure.

There is no doubt that the first thing to be done is to effect the reduction of the mass after it has been properly cleansed. The amount is often many feet, and it is usually distended with gas and fæces; the rent through which it must be returned into the peritoneal cavity is more or less concealed, and the gut constantly tends to pass upward into the rectum. The loops last descended should first be replaced, but the whole mass has seldom been replaced without laparotomy. After reduction the rent in the gut should be sutured if possible, and a posterior division of the gut down and past the coccyx and along the side of the sacrum may render this possible, though it will always be found a difficult undertaking. Nor do I believe it to be absolutely essential to recovery if the rectum be properly cleansed and tamponed with iodoform gauze around a rectal tube.

If the protruded gut be gangrenous, the gangrenous part must be amputated, and the choice remains between circular suture with subsequent replacement, or the formation of a rectal artificial anus by fastening the proximal extremity to the rectum at the site of the laceration. This is evidently what Nature did in her cure of Nedham's celebrated case.

In the third form of prolapsus, the form in which there is an intussusception protruding from the anus, the diagnosis is made by the presence of the sulcus, as before indicated. The depth of this sulcus will sometimes give important information, for the upper part of the rectum may be invaginated into the lower and appear at the anus, or the ileo-cæcal valve may have passed along the whole length of the large intestine and appear as a prolapsus.

It is manifestly impossible to deal here with the whole question of intussusception, but a few practical points may be brought out with advantage.

When the upper part of the rectum becomes invaginated in this

way, the included portion will not always appear at the anus, and the diagnosis can be made only with difficulty.

The symptoms of the condition are peculiar and suggestive, and will often leave little doubt as to the diagnosis if the patient has sufficient intelligence to describe them with any accuracy. The invagination is generally not constant, or at least if it is so it causes no symptoms except in defecation. Then there is peculiar difficulty in the act. The patient strains, and the more the effort the less the result. Finally, when exhausted he gives up the effort in despair, and almost immediately there is a movement. The patient will say that when he strains the bowel becomes closed—that he can feel a tumor which it is impossible for him to evacuate. One of my patients could only relieve himself in the knee-elbow position, and another when lying down. In addition to this it may be possible to feel the tumor with the finger when the patient assumes the natural position for defecation and strains.

The treatment consists in linear cauterization high up in the rectum. This must be done carefully, and not with a Paquelin cautery, but with the old-fashioned olive-pointed actual-cautery iron heated to a black heat only. Too free cauterization here carries great risk of periproctitis.

When the invagination is confined to the rectum, reposition and reduction may be possible by taxis, by enemata, or by passing the hand into the pelvis. A soft rectal bougie passed to the bottom of the sulcus may give great assistance. Failing to accomplish this by gentle measures, combined with anæsthesia and reversed position, there is nothing remaining but immediate laparotomy.

Non-malignant Ulceration.

The many different varieties of simple ulceration of the rectum may for convenience be grouped under the following heads: 1. Traumatic; 2. Catarrhal; 3. Tubercular; 4. Dysenteric; 5. Venereal.

Any wound of the rectum or anus is liable to refuse to heal and to take on ulcerative action, even such a crack in the muco-cutaneous margin as may be caused by the passage of a large mass of fæces. This is the most frequent cause of fissure, or "irritable ulcer," as it has been called from the amount of pain it generally gives rise to. There is no profit in elevating this simple traumatism into a special class, as it differs in no essential respect from other traumatic ulcers in the same location. Fissures, however, cause in different people very different symptoms. Some cause hardly any uneasiness, and trouble the patient so little that he or she hardly cares to seek relief. Others will cause agony during and after the act of defecation, and are the source of a train of reflexes that seem to be limited to no part of the body. Nor is there anything

in the general appearance of the disease which can indicate whether it belongs to the painful or painless class, the secret of the difference probably lying in the fact that in certain cases a terminal nerve-filament is exposed in the sore.

The traumatisms caused by fæcal masses are not, however, confined to fissures at the verge of the anus. Scybalous masses in the large intestine have been the direct cause of death by ulceration and perforation, as in one case of my own ; and I have seen several cases of erosions and superficial ulcerations in the rectal pouch which could be accounted for in no other way than by the lodgment for a length of time of hard fæcal masses in constipated people.

Another frequent cause of ulceration is the traumatism inflicted directly by the surgeon in operations. Some patients heal after an operation quickly, others slowly, others perhaps only with the greatest difficulty or not at all. No factor is so potent in determining under which class any particular case will come as that of rest. More sluggish wounds of the rectum can be cured by absolute rest and proper diet than by all other means combined. This is seen constantly in hospital and dispensary practice. The patient heals rapidly for the first week or two after an operation, and is allowed to leave his bed and resume his work, being told to report in the out-patient room. Then, not infrequently, the trouble begins, and a wound which would have healed in bed in another week is still unhealed, and in fact making no progress, at the end of many weeks.

Another frequent cause of delayed healing is improper dressing and over-medication. This is seen more often in operations for fistula than elsewhere, and is generally due to the false idea that the incisions should be packed daily. It is no uncommon sight to see granulation tissue crushed out of all health and vitality by careful, systematic, and forcible stuffing of an incision with lint.

A not infrequent form of ulceration is due to violence inflicted upon the surface of hæmorrhoids, either in the act of defecation or in replacing them after protrusion at stool ; and this ulceration differs in no essential respect from varicose ulceration in other parts. The ulcers are very sluggish, very difficult to cure, and liable to extend, cause great destruction, and in the end cause stricture. This variety of traumatism is to be distinguished from that due to the injection of hæmorrhoids by any substance capable of producing a slough ; and in this varicose tissue a very weak solution of any of the drugs used for this purpose is capable of doing this. The resulting ulcers are apt to be deep, the cavities have ragged edges and walls, and they may be attended by serious hæmorrhage when the slough separates, and be very slow in healing.

I have seen many severe cases of ulceration of the rectum due to

too powerful medication. Nitrate of silver, nitric acid, strong carbolic acid, etc. are drugs to be used upon the rectum by a skilful hand and with a very definite purpose in view.

Catarrhal ulceration of the rectum may be due to any of the causes capable of exciting a catarrhal proctitis, and a very slight irritation is apparently capable of doing this. In women an eroded spot is not infrequently found just where either the heavy cervix or fundus of the uterus presses upon the rectal wall. Another exciting cause of this form of ulceration is the presence of a perfectly benign polypus, which by the irritation of its mere presence will cause first a catarrhal proctitis in its neighborhood, and then an ulcer with loss of tissue. Some of these cases are very severe.

Tubercular ulceration is unfortunately not an uncommon affection of the rectum. It may most positively be diagnosticated by the discovery of the bacilli under the microscope, and yet its gross appearances are sometimes diagnostic. When associated with fistula the ulceration due to the breaking down of the tubercular deposit is the cause of the fistula, and in such cases the internal orifice of the tract will be found large, and it will be manifest that the first stage of the disease has been due to the destruction of the rectal wall, and that the burrowing has simply resulted from the breach thus made. In such cases when the finger is introduced into the rectum it will drop into a large internal orifice of a fistulous tract. The ulceration when more extensive has an unhealthy varnished appearance, secretes but little healthy pus, is not covered by granulations, and is surrounded by but little induration. The sore ends abruptly in healthy tissue.

There is no doubt that tubercular ulceration of the rectum may be a primary affection, appearing long in advance of any pulmonary deposit, though the opposite is more frequently the case.

Allied to the tubercular process, and yet almost as closely to the syphilitic, is a class of ulcers known as lupoid, which have erroneously been made into a distinct group supposed to have a special pathology, and described in many works under the title of *Estheomène.* In general terms they are phagedenic ulcers attended by great hypertrophy of the nature of elephantiasis, and affecting primarily the skin of the verge of the anus and the vulva. They are most frequent in prostitutes, are not infrequently chronic chancroids, are sometimes simple syphilitic infiltrations, and they may result from any simple traumatism to these parts in a person with the syphilitic, tubercular, or, as we used to call it, scrofulous diathesis. The diagnostic points are their chronicity, their constant tendency to spread in all directions, causing great destruction, their almost invariable accompaniment by great hypertrophy of the adjacent parts, and their very light mortality. I have had for years a patient in New York, whom I see at intervals

either in one hospital or another or on the streets, who is the picture of health. She is a large middle-aged woman, has had the ulcer for at least ten years, is the mother of a family, and yet the recto-vaginal septum is entirely destroyed, and the clitoris and labia are one indistinguishable mass of hypertrophy.

Rodent ulcer is a variety of epithelioma sometimes, though rarely, seen at the verge of the anus, and liable to be mistaken either for true epithelioma or for syphilis. It does not, however, lead to glandular infiltration nor does it yield to syphilitic treatment. Dysenteric ulceration is by no means uncommon in certain parts of this country, and the chronic cases not infrequently find their way into our hospitals for treatment. The ulcers affect by preference the upper part of the rectum and sigmoid flexure, and vary much in size, being generally multiple. This is one great difficulty in the prognosis and treatment of these cases, for when a colotomy is done for manifest dysenteric ulceration of the rectum there is no certainty that the colon may not also be involved above the artificial anus.

The venereal ulcers of the rectum are of numerous varieties, and, though in the brief space allotted to this subject it will be necessary to write dogmatically, there is hardly any part of it which might not be elaborated into a chapter.

Speaking broadly, we will include under venereal ulcers those in any way resulting from the sexual act, and thus include the class of traumatisms due to unnatural vice. Some of these are not specific, and yet very severe ulceration with great loss of tissue may be caused in this way. They are, happily, not frequent, and yet seldom does a year go by without my seeing one or two of them, and as likely in private as in public practice. They are confined to no walk of life, though it is well to be on the watch in negroes, sailors, and prostitutes. Except in their peculiarity of origin they differ in no respect from other simple ulcerations due to traumatism, and their origin will often be confessed without much questioning, though violence is generally given as an excuse.

Proctitis due to sodomy may be either traumatic or gonorrhœal. The symptoms are pain, tenesmus, and a discharge of sero-purulent matter. In gonorrhœa the inflammation is more intense, the purulent discharge more profuse and greenish in color, but the absolute diagnosis must remain with the microscope. The disease is rare, and a severe inflammation of the rectum should not be assigned to this cause without good proof.

Chancroids at the anus are much more frequent in women than in men, because of the facility of auto-inoculation and the possibility of accidental contact and inoculation by the male organ in coition. They

may be due to unnatural intercourse, but their presence is no proof of the vice.

Chancroids may be single or multiple, may be so superficial as to resemble fissures located between the radiating folds of skin, or may become phagedenic and cause great destruction both of the skin and of the rectum itself. They have the same characteristics here as elsewhere: the base is soft, the edges sharply punched, the secretion profuse, and they tend to spontaneous cicatrization. In cases of doubtful diagnosis auto-inoculation should be relied upon for proof.

When these sores take on unhealthy ulcerative action and extend upward, destroying the mucous membrane of the rectum, there is no doubt that with cicatrization they may cause stricture of the rectum; but that this is the usual etiology of the so-called syphilitic stricture of the rectum is very doubtful.

In the rectum, as in the throat or upon the skin, we have secondary syphilitic ulceration following its usual course, only slightly amenable to antisyphilitic treatment, and ending in stricture; and to my own mind it is to this form of disease that the term "syphilitic stricture" best applies. It is not an uncommon form of stricture, and yet it has to bear the blame of many other varieties in no way due to venereal disease.

True chancre of the anus is not very rare, as any one with a large venereal clinic can testify. In women it may be due to accidental contact, while in men it means unnatural vice, there being no question of auto-inoculation. True chancre within the rectum has been several times reported as a great rarity, but how common it may be as a result of unnatural vice will never be known, as it may cause very little local annoyance.

Mucous patches about the anus are very common, and may form ulcers of considerable size, which by neglect and uncleanliness may end in destruction of the soft parts. They sometimes take on a warty, vegetative character—the true syphilitic condyloma.

The diagnosis of the presence of ulceration of the rectum is seldom difficult, though the differential diagnosis of the variety may not in all cases be possible without the microscope. The symptoms of ulceration are pain, diarrhœa, and, above all, the finding of the products of destruction of tissue in the stools. Many of the symptoms of ulceration, such as the frequent passages, the ropy mucus, and obscure pain, may be caused by an ordinary intestinal catarrh; but the presence of blood, pus, and broken-down tissue is conclusive. With the finger also a very superficial loss of tissue can be detected if the examiner be sufficiently expert, and when more serious disease exists its character can generally be decided by this means alone, though it is impossible to give to the reader a knowledge of the different sensations conveyed

by the different forms of disease. Difficulty will sometimes, however, be felt by the most expert in deciding between tubercular and syphilitic disease, or in distinguishing between commencing malignant deposit and advanced non-malignant destruction; and yet by the proper examination, under ether if necessary, and the use of the microscope, the diagnosis is always possible.

Having thus briefly enumerated the different forms of non-malignant ulceration, we come naturally to the important question of treatment, and it may be well to say in advance that the practitioner must prepare himself for much weary waiting, patience, and disappointment; for there is no class of diseases which demands more surgical skill, and which is at the same time less satisfactory to treat.

We will consider first the treatment of those varieties of ulceration in which the indications are plain and easily carried out.

In the irritable ulcer, or so-called fissure, two lines of treatment are sanctioned, either of which will in the majority of cases be successful. The older and perhaps more generally practised is paralysis of the sphincter by forcible division, and the newer and possibly neater and more surgical procedure is incision of the muscular fibres forming the floor of the ulcer. In my own practice the latter is the favorite. It is done either under ether or after injecting cocaine into the cellular tissue under the muscle, and the incision is begun in healthy mucous membrane above the disease, is ended in the skin below the disease, and is made just deep enough to cut all of the fasciculi forming the base of the sore. Entire division of the muscle is unnecessary, the idea being to give the diseased part rest by division only of the muscular fibres exposed by it. This treatment, properly carried out, seldom fails, though in the more trifling cases of erosion, cracks, and superficial ulceration a mere dressing of the spot in the proper way, an ointment, or an application with the brush will often effect a cure without use of the knife. There are many people who suffer from a slight laceration of the mucous membrane of the anus after an unusually hard and difficult stool. In such, a mere touching of the spot with a solution of nitrate of silver (10 grains to the ounce), or a dressing with a few shreds of soft sheet lint, or an ointment of white precipitate made up with cold cream, will effect a cure after two or three days. Indeed, many heal spontaneously.

In all old fissures a polypus hanging down upon the ulcerated surface, and preventing its healing by the irritation of its presence, should be looked for, and if found removed. The association of these two affections is not at all uncommon. Also in many cases a deep and rebellious fissure will be found at the base of an external hypertrophied tag of skin, seemingly produced by the direct tension of the tag upon

the part in defecation. In these cases the removal of the hypertrophy by the scissors will immediately cure the fissure.

Rodent ulcer should be removed completely by the knife, as epithelioma elsewhere should be.

Dysenteric ulceration should be treated by local applications of weak solutions of nitrate of silver (1 grain to 2 ounces), made in the form of voluminous enemata, and by the general rules applicable to all cases of ulceration of the rectum, later to be described.

Lupus, or *estheomène*, is to be treated by destructive cauterization and by iodide of potassium and mercury where there is any suspicion of syphilitic poisoning. The only case of this disease I have ever seen in which medical treatment seemed to have any curative effect was in a child treated for a long time by mixed treatment. After one year of this medication the affection was certainly in a fair way to be entirely cured.

Chancroids of the rectum and anus must be treated by destructive cauterization with nitric acid and dressings of iodoform, and the cauterization must be so thorough and complete that no spot can escape to make a focus for fresh auto-inoculation. This can only be done properly under ether when the ulcer is not at all extensive and occupies any of the radiating folds of skin or mucous membrane.

True chancres of the anus tend to heal spontaneously, as they do in other localities. Mucous patches will heal under constitutional treatment, and the vegetating mucous patch or syphilitic condyloma should be treated both by internal medication and by destructive cauterization.

The later syphilitic ulcerations of the rectum should be treated by mixed treatment, but this should not be relied upon alone. It may do good, but it does less good here than almost anywhere else in the body; and it is always to be remembered that an ulcer of the rectum, though syphilitic in its origin, may very soon reach a stage where it cannot be cured by antisyphilitic medication.

After following these special indications in individual cases, there are some general rules to be noted which are adapted to all cases. And, first of all, it is well to understand that there is no universal panacea and no uniform line of treatment which can be relied upon for a cure. The following experience will illustrate what I mean: a simple fistula was cut by me some months since in my clinic. Several incisions were made, and all healed kindly but one. After many weeks of treatment this one was reduced to the size of the finger-nail, and there remained for four months, the patient attending to his ordinary light work and coming regularly to the clinic twice a week. The attention of the class was frequently called to the case, and all suggestions made by the gentlemen were adopted successively. It may be imagined that many dressings were used, but all with no effect. Finally, to illustrate what

I wanted—rest in bed—I brought the patient into the hospital and promised the class he should be entirely well in one week. I ordered a dressing of balsam of Peru to make sure, and the man patiently kept his bed till, at the end of the week, I showed him to the class—with absolutely no improvement. Being then at the end of my own pharmacopœia, I ordered the house physician to leave him absolutely alone for a few days, only keeping him still in bed; and at the end of four days there was firm cicatrization.

This is by no means an individual case. I have treated patients for weeks in my office with the simplest wounds, and had them get well simply by a rest in bed over a Saturday and Sunday.

This illustrates the first great law in the treatment of all ulcers and unhealed wounds of the rectum and anus—rest in bed. Not rest on a lounge after an hour spent at the toilet and three or four walks to the dining-room for meals in the course of the day; but absolute rest after the plan of Weir Mitchell. To this rest must be added a proper diet, preferably of milk, eggs, and meats. Milk alone is the best if it is well borne, but this may be added to by the things which are best absorbed in the digestive canal and leave the least irritating residue to be discharged by the rectum.

To this general physical rest and unirritating diet may be added local medication—nitrate of silver as a stimulant or caustic, strong acids for destruction and the subsequent excitement of healthy repair, iodoform, dressings of lint and balsam of Peru or red wash, injections of starch and bismuth, each with a definite idea of a certain object to be accomplished, and none blindly on general routine principles.

To the general rest of the muscles of the rectum, pelvis, and perineum obtained by the recumbent posture, more absolute local rest may be added by the use of the knife. To me the reason why many of these sores refuse to heal is to be found in the involuntary contraction of the circular muscular layer of the gut upon which they rest; and this motion is only to be overcome by a free division of these fibres with the knife. This applies as well to ulcers above the internal sphincter as to fissures.

The last means at our disposal is complete excision of the diseased surface or its destruction with acid or the actual cautery. It often happens that an old ulcer of the rectum will not heal while a fresh wound made by its complete removal and the removal of the underlying muscular tissue will heal kindly.

Tubercular ulcers, and ulcers of other varieties which have resisted all other treatment, should be submitted to this. It may seem radical to recommend a complete amputation of a couple of inches of the rectum for a chronic non-malignant ulcer, but I know of nothing else which in many cases will effect a cure, and have more than once

successfully resorted to it after months of other treatment had done no good. The tubercular ulceration may be extirpated exactly as malignant disease would be, with resulting cure.

In many of the bad cases of non-malignant ulceration which cannot be treated by excision or made to heal by local applications or by general treatment, colotomy is the only resource, and in these cases the operation shows its greatest benefits. Colotomy in malignant disease is but palliative at the best, but in non-malignant disease it is curative, and in cases incurable by other means the surgeon is not justified in withholding from the sufferer the relief it is sure to give. Moreover, in these colotomies the artificial anus should be so formed as to permit of closure by a subsequent operation. This is a promise I always hold out to these patients, and am always ready to fulfil should they desire it and the condition of the rectum indicate it; but the contrast between the former suffering and the comfort of the artificial anus invariably prevents their return to the old condition of things. I have had ladies tell me that nothing would tempt them to have the artificial anus closed; and not long since I caught three of my colotomy patients in an earnest discussion on this subject—their unanimous verdict being that they were entirely too comfortable as they were to care to take any chances of having the inguinal opening closed.

Non-Malignant Stricture.

The following table will be found to include all of the varieties of non-malignant stricture of the rectum:

- *Congenital.*
  - Partial,
  - Complete.
- *Acquired.*
  1. Spasm.
  2. Pressure from without.
  3. Non-venereal.
     - *a.* Dysenteric.
     - *b.* Tubercular.
     - *c.* Inflammatory.
     - *d.* Traumatic.
  4. Venereal.
     - *a.* Ulceration (either chancroidal, secondary, or tertiary).
     - *b.* Due to unnatural vice.
     - *c.* Neoplastic (gummata, ano-rectal syphiloma).

The congenital narrowings of the rectum, both complete and partial, have been already described under the head of Malformations, and

attention has been called to the fact that the condition is sometimes shown only by the presence of obstinate constipation, till an examination late in life proves the existence of a congenital narrowing, which at the age of thirty-five or forty begins to cause all the usual symptoms of an acquired stricture.

Strictures due to pressure from outside the gut are not at all uncommon. A tumor of any kind in the pelvis, an old pelvic cellulitis in women, a cancer springing from the promontory of the sacrum, may, any of them, cause sufficient pressure to lead to intestinal obstruction.

Spasmodic stricture of the rectum is still, as spasmodic stricture of the urethra used to be, a subject of animated debate; but the whole question now rests upon clinical evidence. Have observers whose word is beyond question ever met and described a true spasmodic stricture of the rectum? Spasm of the external sphincter from any cause, such as fissure, is not included in the question.

In answer we think we may safely say that true spasmodic stricture, caused by contracture of the involuntary circular fibres of the rectum, has occasionally, though very rarely, been observed and reported by those whose dictum is worthy of all credence. Allingham upholds its existence as a phenomenon grafted upon organic stricture, and calls attention to the fact that there may be very little deposit and much spasm—a spasm which disappears after the administration of ether. Spasmodic stricture of the rectum is a thing easy to diagnosticate—one which has been exceedingly profitable to the quacks for many generations, and yet one seldom seen by men of authority. In general it will be found to rest upon the fact that the unskilful examiner does not know just how to guide a bougie beyond the promontory of the sacrum.

Nevertheless, as my own observations have multiplied I have come to have greater faith in the possible existence of this condition as a great surgical curiosity. I have never seen anything that could properly be so classified but once in many years' practice of my specialty. That case is perhaps on that account worthy of notice:

The patient was a very nervous physician, worn out with suffering from disease of the rectum, and having also cancer of the stomach. His one great symptom was pain in the rectum, caused by defecation, increased by the sitting posture, and lasting often for many hours after defecation. On touching the skin near the anus in an attempt to separate the parts, the pain was so intense as to cause him to cry out. With the utmost gentleness the finger was passed through the external sphincter, and about an inch above—or, in other words, at the upper level of the internal sphincter—it was met by a tight stricture. A few days later he was etherized—the same stricture being verified by myself and my assistant before the ether—and only after profound

narcosis did the contraction disappear. The patient was suffering from hæmorrhoids and from an erosion over the internal sphincter. The removal of the hæmorrhoids and incision of the ulcer effected a perfect cure.

Here, then, we have distinct spasmodic stricture at the level of the upper limit of the internal sphincter, associated with other disease. Does the same thing occur higher up in the rectum, and without other disease? To a certain extent I am also ready to put myself on record (as I have never done before) in the affirmative. This much I have certainly appreciated more than once. On introducing my finger into the rectum of a patient (generally hyperæsthetic) I have found it tightly grasped at a point as high as I could reach. Leaving it there for a few seconds, and gently palpating for disease or for a free opening upward, I have suddenly felt the whole canal open up and balloon out, leaving the finger in a patulous cavity. If we may have contracture to such a degree, why not more?

The non-venereal strictures are the direct sequence of the various forms of non-venereal ulceration.

Dysenteric stricture, though often denied as a result of dysenteric ulceration, is not at all uncommon. On this point I think most pathologists will agree with me. These strictures, moreover, are very apt to be extensive, are surrounded by much inflammatory deposit, strongly resemble what are usually called "syphilitic strictures," and hence are perhaps not recognized under their proper etiology.

Proctitis, acute or chronic, and periproctitis, acute or chronic, may either of them lead to sufficient thickening to produce stricture. Periproctitis, as has been mentioned, often results in great destruction of tissue, and, should the patient recover, to great subsequent deformity. The various forms of traumatism which result in stricture come under this head.

Tubercular ulceration, when it causes stricture, does so simply from inflammatory deposit and induration, and seldom from cicatricial contraction. There is not often sufficient cicatrization in tubercular disease to cause a stricture from contraction of the cicatrix.

The venereal strictures (and we wish distinctly to distinguish between the words "venereal" and "syphilitic") may be either cicatricial or neoplastic. Certain of the venereal ulcers will cause cicatricial strictures. These are the chancroids and the later syphilitic ulcerations. The true chancre and the mucous patch we leave out of consideration for lack of space for full discussion.

There is a class of venereal strictures, however, which are not primarily ulcerative, and hence not cicatricial. In this class are to be included the gummata and what has been described under a special name by Fournier as ano-rectal syphiloma, but which is in reality

apparently a form of gummata. These syphilitic deposits occlude the rectal wall by their mere presence, instead of closing it by ulceration and subsequent cicatrization.

The symptoms of stricture are almost invariably, except in cases of congenital contraction, associated with those of ulceration, and masked by them. Flattening of the fæces is a sign of doubtful importance. Spasmodic action of the external sphincter may cause typical tape-like passages, and a stricture high up in the rectum which will easily admit a No. 8 rectal bougie will do the same when the mucous membrane above is crowded down into it in the act of defecation. Ballooning of the rectum, which Bryant has recently called attention to as a sign of stricture, may be due equally to chronic constipation and loss of tone. Even the long bougie may lead to error in examination for this condition, as a stricture is often said to exist simply because the instrument fails to pass the promontory of the sacrum, and is said not to exist because the instrument passes its full length. Whereas, malignant disease may be present, and to a sufficient extent to cause fatal obstruction, even in cases in which a medium-sized bougie can be passed without its detection.

Stricture within reach of the finger can always be diagnosticated by digital examination. Nothing is more difficult than to diagnosticate with certainty the existence of stricture in the upper rectum or sigmoid flexure beyond the reach of the finger. In my own practice should I fail after repeated attempts to pass a bougie its full length of twelve inches, I should be willing to commit myself to a diagnosis of contraction of the gut; but success in passing the bougie would not lead me to say a patient had no serious disease, or even dangerous stricture, did the symptoms point to such a condition. It must always be remembered that a stricture of large calibre, one admitting a No. 8 bougie, may be fatal when located in the upper and more movable part of the rectum or in the sigmoid flexure. This is easily explained by the anatomical relations. It is often a source of wonder how a patient with almost complete closure of the lower rectum can go on for years passing small deformed masses of fæces, and yet prevent fatal obstruction. The reason lies in the fixity of the gut at this point, and in the fact that the whole muscular force of the body can be brought to bear upon the fæcal mass, which is thus driven through a very narrow passage from which the fixation of the lower rectum allows of no escape. In the sigmoid flexure and upper rectum the conditions are changed. The force of the abdominal muscles, acting upon the fæcal mass, may cause a bending of the movable gut upon itself, and merely increase the existing difficulty by adding a sharp flexure to an obstruction. For this reason a slight stricture high up is much more dangerous than a tight stricture low down.

In the diagnosis of stricture we trust to the finger, the bougie, and the whole hand in the rectum; and all of them may deceive us. Very few weeks pass that I am not called upon to differ with some brother practitioner in the diagnosis of these cases, generally, I am glad to say, in the way of doubting the existence of disease which has before been affirmed; but I never do so without freely admitting to myself the inherent difficulty of discovering the condition of a part of the gut which can neither be seen nor felt.

In the surgical treatment of non-malignant stricture we have to choose between four methods: 1. Dilatation; 2. Division; 3. Excision; 4. Colotomy.

Dilatation, either alone or subsequent to cutting, is a means of the greatest value, but it must be carried out with skill and patience. No dilatation which causes pain can be productive of anything but harm. The bougie must act not by forcible stretching, but by causing healthy absorption and resolution. When a surgeon passes a medium bougie without pain, and follows it by one of larger diameter which does cause pain and cannot be borne, he has done just so much harm, and delayed instead of expediting cure. A bougie that can be passed through a stricture, and left in for hours while the patient is asleep, does good; one that can just be forced through, and has to be immediately withdrawn, does harm. In some strictures of the anus I have begun with a small hard-rubber bougie, which was nothing more than a uterine stem, and in a few weeks have had the patient wearing a No. 8 all night unconsciously; while a little overhaste in the outset has produced fissures which delayed the treatment for weeks.

By long-continued use of the bougie after the operation of free linear division I have seen as near an approach to absolute cure of stricture as I have ever seen—much nearer than by any other method of treatment except excision. That is, I have seen absorption in great part of the induration, cessation of all blood and mucus discharges, due to healing of the attendant ulceration, daily, painless, well-formed passages, and patients considering themselves absolutely cured and reporting to me only at long intervals. Naturally, such a result requires time. It is a treatment for the rich, and not for the dispensary, and, above all, it requires intelligent perseverance on the part of the patient. For these reasons it is a plan which promises the best results in the better class of private practice.

To save time in dilatation I usually prefer to do a preliminary proctotomy, or free division of all of the stricture tissue in the posterior median line. This is an operation which by itself was at one time much vaunted by the French surgeons as an absolute cure. I have never found it so. It is analogous to an internal urethrotomy, and we all know how little that accomplishes unless followed by dilatation.

By proctotomy I mean always a complete division of the stricture, and of the anus and soft parts below it, down to the tip of the sacrum, to allow for free drainage. Division of the sphincter alone, without this provision for drainage, is a very dangerous operation, the cellular tissue of the pelvis being opened into and constantly bathed in purulent and feculent discharge.

Following Weir, I have attempted to avoid the free division of the sphincters (a wound requiring weeks to heal) by passing a drainage-tube from the bottom of the incision through the stricture, out through the skin at the tip of the coccyx. Some of these cases have done well, some have not. The free incision is the safer method.

Let me describe a case which will illustrate what can be done by a combination of these two methods. The patient was a gentleman of middle age with a very extensive non-malignant stricture, traumatic in its origin, existing for twenty years, and extending higher than the finger could reach. So extensive was it that a celebrated English specialist ten years ago declined to operate upon it, and regretted that he had not seen it before. The patient had all of the usual symptoms of the condition, and his life was becoming a burden to him with the frequent calls to stool, the constant discharges of blood and slime, and the inability to observe ordinary cleanliness of person or to enjoy the usual sociabilities of life.

He wished me to operate, and I was willing to do so. My index finger failed to reach the upper limit of the disease, even after free division of the soft parts down to and beyond the tip of the coccyx. I divided as far as I dared, momentarily expecting to open into the peritoneum through the posterior wall of the gut. Fortunately, the peritoneal reflexion was high up, and this fatal accident was avoided. The operation was not at all to my mind—in fact, I practically abandoned it without completing it—and the patient made a slow convalescence. After a couple of months I was delighted to find that all but the upper end of the stricture had been cut, and that a bougie could be made to pass through what remained.

The result, after one year of treatment, is this: The patient passes a No. 12 bougie three times weekly, and leaves it in half an hour. He has one passage daily in the morning by the aid of an enema, and has no more trouble with his bowels for the twenty-four hours. The discharge of blood and pus has so far decreased under local applications to the ulcerated surface that he has abandoned his old dressing of a large pad of absorbent cotton and a cloth, and a simple pledget of lint laid against the anus suffices to catch all discharge for six or eight hours. He is still improving, and the discharge can be still further diminished, while the calibre of the rectum can be maintained.

This is an unusually successful result, only obtainable in a man of

sufficient means to devote time to a cure. In such a case ordinarily the best treatment would be a colotomy, but I relate the case as an example of what under favorable conditions can be done by proctotomy and dilatation.

Proctotomy is not without danger of fatal periproctitis. In cases of extensive disease my own statistics tend to show that it is quite as fatal as colotomy. In such a case as the one just related the risk must be much greater in the former than in the latter.

The excision of benign stricture is one of the steps of progress in the surgery of the rectum of the last decade. When the disease is of such a character that it can be resected and the ends of the gut brought together and sutured, there is no doubt that it gives the best results possible in many cases. Personally, I have only applied it to disease of rather limited extent, covering only a couple of inches of the gut longitudinally, and where the induration was not so extensive but that a section of the rectum could be excised without encroaching to any great extent upon the pelvic circular tissue or the peritoneum. In other words, I have not carried the operation to the same extent that would seem justifiable in malignant disease, and have not taken with it the same risks of fatal results, being guided by the idea that, though perhaps not cured, these patients could be made comfortable by less serious measures, including colotomy.

Inguinal colotomy has a wide range of applicability in non-malignant disease. By it all suffering can be relieved and a life of constant annoyance changed at once to one of comparative comfort. Indeed, the operation gives much greater satisfaction here than in malignant stricture, though no greater relief; but in cancer the operation only delays the inevitable end, while in non-malignant disease it is curative.

Cancer.

About one half of all the cases of stricture of the rectum will be found to be cancerous, while the remaining half will be divided among the various classes in very different proportions. It is a popular idea in the profession that most strictures are either malignant or syphilitic, but a careful study of the non-malignant cases will reveal a smaller number than is usually imagined in which any venereal origin can be shown. It is by no means justifiable to suspect a patient of venereal disease simply because he or she is suffering from a non-malignant stricture.

A collection of over one hundred personal cases shows the relative frequency to be as follows:

Males	70
Females	59
Cancer	59

Venereal	17
Non-venereal	33
Doubtful (non-malignant)	9
Congenital	5
Due to pressure	2
Spasmodic	1

Cancer in the rectum is usually seen in one of two varieties—epithelioma or scirrhus. In epithelioma we have the characteristic ulceration with raised, hard edges, and in scirrhus the deposit of new material in masses of greater or lesser size in and around the rectal wall. Other varieties of malignant growths do occur, and occasionally it will be very difficult, either by the gross appearances or the microscope, to decide between a benign and malignant adenoma. Benign growths tend to become pedunculated and grow away from the rectal wall, hanging loose in the calibre of the gut, while malignant ones tend to infiltrate the gut itself, and increase by the deposit of new tissue around the point of origin.

The length of time the disease has existed is of great importance in the diagnosis. When a middle-aged patient says he has suffered from the usual symptoms of ulceration for a year or two, has lost flesh, and is steadily growing weaker, the suspicion of malignancy should always be aroused. When, on the other hand, a patient tells you he has had stricture for a number of years, and is not much worse now than at any time for years past, although the feel to the finger may be much the same as in the last case, the disease is not malignant.

I do not hesitate to call attention to these difficulties of diagnosis, because, though in most cases the diagnosis is easy to the experienced examiner, in others it will not be found so; and this difficulty is one readily acknowledged by most surgeons. I have seen dysenteric stricture that I should have unhesitatingly pronounced scirrhus had not the patient assured me he had suffered from it at least fifteen years.

The symptoms of cancer of the rectum differ in no way from those of non-malignant ulceration and stricture. The disease may be very insidious in its progress, and attended by slight pain and discharge, so that it may be far advanced before the patient suspects that he has anything but piles; or it may be attended by great pain almost from the commencement, and this pain may be reflected to the loins, thighs, genital organs, or any neighboring part.

Coming now to the question of treatment, we approach a subject which has been fruitful of much discussion—one in which the landmarks of former days have been entirely swept away, and in which every surgeon is still a law unto himself. My own ideas have been very conservative, and I have hesitated to adopt a radical practice which is nevertheless perfectly justifiable, as shown by the experience

of others. From the first, where the disease was easily removable I have of course removed it—cases in which the growth was circumscribed, was near the anus, and did not invade the peritoneum or adjacent organs. Cases of more extensive disease were treated in a palliative way, but colotomy, the greatest of all palliatives, I for a long time avoided, being led by an erroneous idea of the disgusting deformity which, with most others, I dreaded to inflict upon the patient.

From this last position I was soon driven by one or two cases of death from intestinal obstruction which should have been treated by an artificial anus, and in which life might have been prolonged and an easy death substituted for one of great agony. A few colotomies were sufficient to prove to me that this was our greatest resource in relieving pain and prolonging life in cases unfit for radical operation; but the next question demanding an answer was, What cases should be abandoned, so to speak, to colotomy, and in how extensive disease were we justified in giving the patient the chance of cure which a complete removal of the disease offers? Even on this point my practice has become much more radical, and I now extirpate in every case in which it seems physically possible to remove the entire growth.

On this point every surgeon will be guided in his practice by the results of his own experience. The success when obtained is brilliant and very encouraging, but failure is very depressing when we think how much longer the patient might have lived, and in what comfort, had we been content with a simple colotomy and its comparative safety of performance. Through about this course of education by experience every conscientious surgeon who sees many of these cases has to go, but meantime we have learned much.

Many of the older methods of attempted palliation have been abandoned as the advantages of colotomy have come to be accepted by the profession at large; and this applies with great force to such feeble efforts at relief as curetting; partial destruction or removal of the growth by caustics, knife, or electrolysis; dilatation; and even proctotomy.

This last operation is one from which great things were expected as a substitute for colotomy, but it has not stood the test of time for malignant stricture, though of great value in non-malignant. In malignant stricture the incision cannot be followed by effective dilatation, and it rapidly fills up, while the operation itself in my own experience has been attended by high mortality. It is, to my mind, a more serious procedure than a colotomy, its dangers arising from shock and secondary hæmorrhage, and it bears no comparison with the latter in amount of relief afforded.

In all cases of cancer of the rectum we are reduced, therefore, to one of two plans of treatment, colotomy or excision, the only question being as to proper selection of one or the other.

Colotomy is applicable to all cases. It can never be contraindicated where the patient is not already too far gone for its probable safe performance. It is an operation attended by little danger and sure to give relief, to prolong life by allaying pain, and to retard the growth by removing the greatest of all sources of irritation. Never have I performed the operation and had reason to regret doing so from failure to obtain the expected relief; and in a few cases in my earlier practice I now greatly regret not having done so.

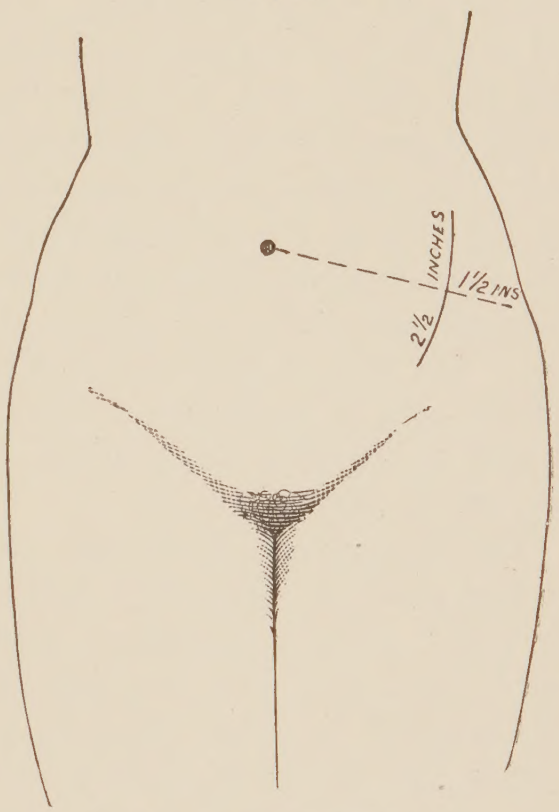
As to the choice of operation, inguinal or lumbar, I greatly prefer the former. There has been much recent discussion on this point, and within a year Bryant, the father of the lumbar incision, has once more said all that can be said in its favor, but without changing the prevailing tendency amongst the surgeons of to-day in favor of the inguinal operation. The one argument he advances which is unanswerable is that in cases of great abdominal distension from intestinal obstruction the lumbar operation is the easier of performance; and this is true, for the very distension which may add great difficulties to the inguinal incision is an assistance in the lumbar by forcing the desired coil of gut out of the incision made to reach it. Granting that this is true, and that the seat of the obstruction is known to be below the point of the lumbar incision, the operation in the loin may be chosen in those cases with advantage. In all other cases the advantages will be found to apply to the operation in the groin. The operation here is easier of performance, the artificial anus is directly within the sight of the patient for cleanliness and dressing, and, above all other reasons, the opening in the gut is much better adapted for subsequent closure if desired. Again, the opening in the gut may be adapted at will to the particular end in view. If it be made as a preliminary to a subsequent resection of the rectum, or if it be done for a curable non-malignant ulceration with the idea of subsequent closure, it can be so made as to admit of closure by a simple plastic operation without resection and suture. If it be intended as a permanency, it can at will be made so that no fæcal matter shall ever again pass into the segment of gut beyond the opening. That this is a matter of no slight moment is shown by Bryant's statement that in only three-fourths of his lumbar operations has he succeeded in accomplishing the great end of the operation—the prevention of the passage of fæces over the diseased surface.

The line of incision for inguinal colotomy is shown in Fig. 86. A skilful operator will have no difficulty in cutting down upon the peritoneun and exposing it to the full extent of the cutaneous incision without using a director, which takes so much valuable time. When the peritoneun has been exposed, any spouting vessels in the wound should be secured before the abdomen is opened. After the peritoneum has been seized with dissecting-forceps and snipped, it is

best divided with a pair of straight blunt-pointed scissors; and as it is incised an assistant should follow the incision and seize the free ends of the membrane at half a dozen points with dressing-forceps, which are left hanging in the wound. These save much time lost in searching for the free edge of the peritoneum during the subsequent suturing.

The large gut must next be found. It may, and often does, present in the incision. It is recognized by the strongly-marked longitudinal bands of muscular fibre, by the thickness of its walls, and by the *appendices epiploicæ*. Error, and serious error, may occur at this point unless the operator is familiar with the look and feel of the large bowel as distinguished from the small. A longitudinal band may be made to appear quite plainly in the small gut by a little tension which gathers the normal longitudinal muscular layer into a band. There is never any excuse, however, for mistaking one for the other.

FIG. 86.



Incision for Inguinal Colotomy.

If the sigmoid flexure does not present in the incision, a finger passed down to the brim of the pelvis will usually at once bring it to light. Should it fail to do so, the finger may be passed from the outer border of the incision along the abdominal wall down into the iliac fossa, and the gut met in this way. Usually, to a cool and deliberate operator there is little difficulty, but there may be much; and there is nothing to do but to find the gut by gentle searching.

I have seen some awkward pauses just at this stage of the operation, and I myself always feel a little relieved when the gut with its well-marked characteristics comes to the light, for, as I have often explained when operating in public, no man knows exactly beforehand what he will find when he has opened the abdomen for a colotomy. In one case we found the gut bound down to a uterine fibroid by strong adhesions, and were obliged to open the colon much higher up, where another coil presented. Great variations I have also found to exist in the mesentery of the sigmoid flexure. In one of my cases there was no mesentery to the lower part of the flexure. It was bound firmly to the iliac fossa, and, though I could pass a finger under it, I could not

raise it into the wound to fasten it. Fortunately, the upper part of the sigmoid was free.

I relate these difficulties simply that the operator may be prepared for them, and need not be unduly overcome by them. Usually, the gut will be found with slight difficulty, and the operation may be proceeded with as follows: My own operation differs somewhat in its next step from that of others, in that a silver-wire suture is passed entirely under the gut to secure it in its position, and also to secure an effectual spur. Formerly I used a hare-lip pin for this purpose, but a properly arranged silver wire, with shot-and-shield fastenings, is preferable, because more easily introduced. The suture is passed as follows: One end of a silver wire twelve inches long is arranged with the perforated shot and shield, and the other threaded to a suitable needle. The needle is passed through the entire thickness of the abdominal wall one inch to the right of the incision, then through the mesentery of the gut, and out through the entire thickness of the abdominal wall on the other side of the incision, far enough away from the wound, so that the shield when adjusted shall not impinge upon the gut when fastened in position. The wire is then drawn more or less tightly according to the kind of spur it is desired to form, the needle is cut loose, the shield slipped on the wire down to the skin, the shot after it, and clamped with strong forceps.

The object of this wire suture should be thoroughly understood. In the first place, we know there will be no tearing of the gut away from the wound while it remains in position—an accident which has happened more than once in coughing or vomiting when the ordinary sutures of silk have been the only ones used. Again, this wire can by more or less tension be made to form any flexure in the gut desirable, and any sort of spur. Drawn tightly, the operator can produce by it an absolute obstruction. Now, a spur should be more or less extensive according as the operation is intended to be absolute and final or only provisional. In provisional artificial anus the less spur consistent with complete emptying of the bowel through the artificial anus the better, for the opening is the more readily closed by a simple plastic operation covering it over, and resection of the ends with subsequent suture, which is a much more serious operation, may be avoided. On the other hand, in permanent artificial anus where there is no probability of ever attempting to close the opening, the more marked the spur the better will the fæces be directed out at the artificial channel.

Another point in passing this suture is to introduce it not across the middle of the cutaneous incision, but on the level of the junction of the middle and lower thirds. By so doing, when the outer wall of the gut is cut away two openings are left—the upper, larger one above the spur, allowing for the free escape of fæces, the lower, smaller one below

the spur, allowing for washing out of the distal portion of the gut, but not being free enough to allow even fluid fæces to get into it and pass down to irritate the diseased part.

The next step in the operation is the suturing, and here, again, operators differ. The stitches are so passed as to unite the serous surface of the gut to the serous surface of the abdominal wall, and at the same time to fasten the gut to the skin. In other words, each suture includes the skin of the margin of the incision, the cut edge of the parietal peritoneum, and the serous and muscular layer of the gut. The sutures should not perforate the cavity of the gut. Six or eight of these stitches are sufficient to give apposition of the two serous surfaces, with the wire suture to prevent displacement. But it is evident that the sutures may be so passed as to fasten almost the entire calibre of the intestine outside of the abdominal cavity, and above the level of the skin, by introducing them into the wall of the gut close down to the mesenteric attachment; or, on the other hand, that the free edge of the gut may be fastened to the skin incision in such a way as to leave almost all of the intestinal loop below the level of the incision.

In some cases it is well to follow one plan, and in others the opposite will best give the required result; and in this adaptability of the sigmoid flexure lies one of the great advantages of the inguinal over the lumbar operation. In a general way, the rule is this: If a permanent opening is made for incurable disease, the wire suture should be tight, and the silk stitches should be passed deep down by the mesenteric attachment to draw the calibre of the intestine well out of the abdomen. If, on the other hand, the opening is intended as provisional only, the wire suture is not drawn as tight (may even be omitted altogether), and the silk sutures should be inserted farther away from the mesenteric attachment.

In suturing additional firmness may nearly always be gained by passing the stitches through one of the longitudinal bands. Occasionally two of them can be utilized in this way, but generally only one will be available.

There are but few cases in which the obstruction is so great as to render an immediate opening of the gut necessary, and in them it can be done with perfect safety if proper care be taken to get accurate apposition of the serous surfaces. Even a few hours' delay, however, is an advantage, in that it allows of closing the peritoneal cavity by plastic exudation. This exudation is very free, and should be provided for by a dressing of protective next to the skin to keep the other dressings from touching the parts. Unless there is a decided call for haste in opening the gut, I usually leave the first dressing undisturbed for forty-eight hours. The gut is then incised without ether by puncturing it with a sharp bistoury, and then cutting away the superfluous gut

with scissors. Here, once more, the operator must be guided by the circumstances. In provisional artificial anus as little of the wall of the gut should be sacrificed as possible, and the operator should be content with a mere longitudinal incision into the wall. In other cases the free edges of the gut may be trimmed off to within a quarter of an inch of the skin. The silver wire may be removed by the end of the third or fourth day, and the silk sutures a few days later. The bowels may move through the artificial anus immediately after the gut is opened, or it may be a week before any fæces escape.

After the operation I always provide the patient with a well-fitting truss with hard-rubber pad, to be worn over the artificial anus during the day.

One's experiences with this operation are always full of interest, for, though manually perhaps not a difficult one, it is the unexpected that always happens, and which the operator must be prepared to meet. I have found the sigmoid flexure so diseased that it was impossible to open it, and have had to use the transverse colon instead. This case gave no support to Bryant's argument that the lumbar incision is better—that the opening is farther away from the cancer of the rectum—because the descending colon could not have been opened at any point. The difference in location between the lumbar and iliac openings is not as great as is imagined. When the gut is pulled well down into the inguinal incision, the artificial anus can be made within two and a half or three inches of the spot opened by the lumbar operation. Cases of course may arise in which the additional distance would be important, but they seldom do, as the operation in the majority of cases is for disease of the rectum and not of the sigmoid flexure.

I have seen the gut fastened into the inguinal incision in the reverse position, so that when the opening was made the fæces were evacuated from the lower angle of the wound, and the upper was the distal portion of the gut. Such reversing of the gut may easily happen, especially after a considerable search has to be made for the sigmoid flexure and it is drawn some distance from its natural bed to fasten it into the wound; but I do not know that any harm results from it.

With the exception of these minor difficulties I have never encountered any accidents in the operation of colotomy. Two or three times in cases of obstruction there has been considerable evisceration, but I have never had to resort to incision for relief of the distension. A short mesentery may at any time render the operation more difficult than it would otherwise be, but I have seen only one case in which some part of the descending colon or sigmoid could not be brought to the surface with ease. In that case the entire mesentery was so infiltrated with cancer that it was with great difficulty that any piece of gut, small or large, was found healthy enough to form a new anus with.

The subsequent condition of patients with artificial anus is worthy of note. I know of no single point upon which public and professional opinion generally is more at variance with the truth than this. The prevailing idea, that the lives of these patients must be miserable, that they are loathsome objects, suffering from a continual flow of fæces from the groin, is to any one with experience in these cases simply laughable. The comfort of an artificial anus necessarily depends much upon the skill with which it is made, as has been clearly shown in the description of the operation. It is an easy thing to open the sigmoid flexure, but the kind of opening depends very much upon the operator, and the patient's comfort much upon the kind of opening. A certain amount of prolapse of the mucous membrane is the most frequent cause of after-annoyance, and this cannot perhaps be avoided in every case; but it is a self-reducing prolapse when the patient lies down, and it can be kept in by a properly-fitting truss. As to passages, there is little discomfort when the fæces are solid. Usually, after a few weeks, the bowels acquire the habit of a single daily evacuation, and this is preceded by a sufficient warning. Occasionally, as in the normal condition, there will be an evacuation both night and morning; and one patient writes me that her bowels move only every second or third day, and sometimes only after a laxative.

In a general way, then, I can only say that my patients are happy in the relief afforded by the operation, and do not suffer either mentally or physically from the deformity. In cases in which the opening has been made for non-malignant ulceration, which has been cured by the operation, I have sometimes been quite anxious to close the artificial anus and restore the parts to their normal condition, but so far none of my patients have been willing to take the chance of a return to the old state.

Not long since I operated upon a poor little emaciated woman with cancer of the rectum, whose sufferings had driven her to attempt suicide by taking Paris green. The attempt was a failure, and I did a colotomy, extirpation being out of the question. At the time of the operation she was spending most of her days and nights upon the water-closet. Four weeks later she walked into my clinic, smiling and happy, suffering no pain, and yet with a marked increase in the amount of the disease, which was rapidly involving the mesenteric glands and the external organs of generation. Ten weeks after the operation she had gained eight pounds. She was steadily approaching the end, but considered herself on the road to recovery. This is what colotomy will do, and there is nothing else known to science that will do as much.

Regarding the dangers of the operation itself, a word should be said. The mortality may be either high or low in any man's table of

operations, depending on himself. Cripps gives 41 cases and 1 death; Bryant in 140 cases 50 per cent. mortality. My own are greater than Cripps's, less than Bryant's. Cripps selects his cases carefully—from the figures one would be inclined to suspect too carefully. It would not be at all difficult for Bryant, or even myself, to select 40 cases and operate without a death, but if the operation be done on the cases in which it is indicated as they present themselves, the death-rate will be higher. I myself have operated only a few hours before death because I believed it a duty to give the patient the chance, hopeless as it was.

In any case, however, the danger of the operation can be very closely estimated beforehand. I often say, "Gentlemen, the risk of this operation is scarcely 1 per cent."; or, again, "This patient may survive the operation but a few hours." The high mortality in the old cases of chronic intestinal obstruction, and the risks directly arising from the operation itself, where the gut is sound and the patient has any reserved strength, are very slight.

With this means of certain relief in our power, therefore, is it to be wondered at that certain surgeons hesitate to operate directly for the removal of the cancerous growth when we consider the mortality of that operation and the discouraging nature of the statistics as to immediate recurrence? And yet a removal of a cancer is much more to be desired than any mere palliation. There is no doubt that the statistics of extirpation are on the whole bad, but in some cases a return has been delayed six, eight, or nine years—in other words, a practical cure has been achieved. Colotomy can never do this.

This brings us face to face with the question, In what cases are we justified in balancing the risk of a fatal operation against the chance of radical cure, such as it is? and, In what cases should we be content with the certain relief and prolongation of life to be had from colotomy? It is a question on which even national schools of surgery differ in their teaching and practice. The English are very conservative. Where the disease is within easy reach, and can be entirely removed by dissecting upward from the perineum, they agree with all the rest of the world that it should be removed. In all other cases they practise colotomy. The Germans, on the other hand, set no limit to the operation except involvement of adjacent organs, and, beginning the dissection from above, remove the entire rectum and anus. Their mortality is high, but their results are brilliant in some cases, and they have certainly proven the surgical possibility of removing much more extensive disease than was ever done before the teachings of Kraske.

The Germans also have brought into practice an entirely new operation—the resection of cancer high up in the rectum, exactly as cancer of the gut elsewhere may be resected, and the ends joined by

circular suture, thus bringing within the scope of operation a class of cases hitherto abandoned as hopeless or else colotomized and left to their course.

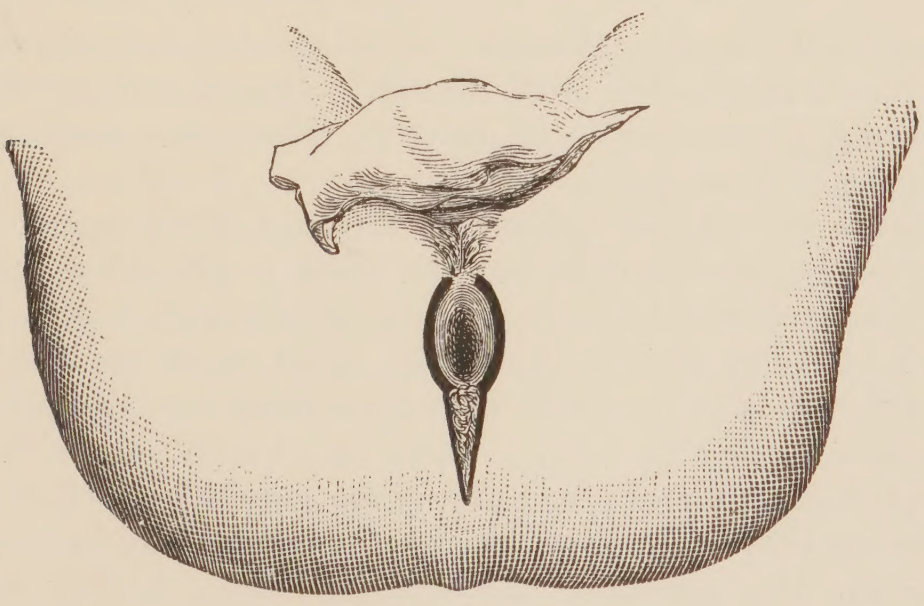
As to my own practice, I can only say that from being very conservative it is becoming more radical. The whole rectum can be removed, and when successfully done much more has been accomplished than results from a colotomy. Of course a life is sometimes shortened which might have been prolonged by a colotomy, but, on the other hand, a success in entirely removing extensive disease encourages one to renewed attempts.

In amputating the lower end of the rectum in cases where the finger can reach above the disease, the operation I prefer is the one marked out in a general way by Allingham, Jr. It certainly possesses some advantages over the other methods I have tried, and is performed in the following manner:

The patient is placed in the lithotomy position, held so by Clover's crutch, and the buttocks are elevated upon a round hard pillow. The rectum is thoroughly irrigated with bichloride solution 1 : 2500, a Sims's bivalve speculum being introduced to permit the escape of the fluid.

Taking first a case in which the growth involves the skin of the anus, the knife (a long, straight, sharp-pointed bistoury) is entered in the skin between the anus and coccyx, and passed directly upward

FIG. 87.



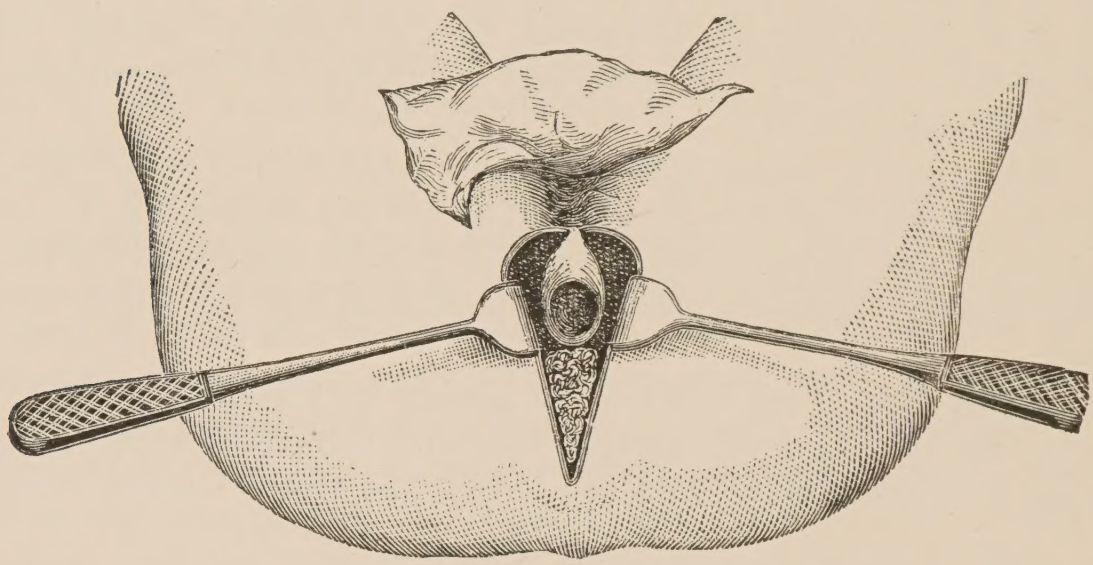
Primary Incisions for Extirpation of Rectum.

behind the gut and parallel with it, the index finger of the left hand being in the gut for a guide. When the end of the blade has passed beyond the limit of the disease, the handle is depressed and an incision

is made in the median line behind from the point of puncture down to and somewhat past the tip of the coccyx.

Two semicircular incisions are next made with the knife which completely surround the anus, as shown in the cut (Fig. 87). These should also be deep, reaching well into the fat of each ischio-rectal fossa, and not merely through the skin. The knife is then abandoned, and with a pair of long-handled, straight, blunt-pointed scissors these semicircular incisions are rapidly, by bold cuts, deepened till they pass the upper limit of the growth by at least half an inch, as shown in the cut (Fig. 88). Finally, the rectum is stripped from its attachments

FIG. 88.



Second Stage in Extirpation.

anteriorly with scissors and finger, care being taken to avoid wounding the deep urethra and neck of the bladder. Having thus circumscribed the anus and gut to a limit well above the disease, it is seized with forceps, drawn down, and amputated.

There are two ways of performing this part of the operation: One is to tie each vessel as it is cut; the other, to proceed as rapidly as possible, making deep incisions with the scissors, and trusting the control of the bleeding to an assistant, who rapidly packs the incision with sponges as the operator works his way upward into the pelvis. In either case the operation will necessarily be a bloody one, but the latter method is the one I prefer, as being in the end the least bloody of the two. Often after the pressure has been continued a few minutes, and the gut has been cut across, the upper end being held by forceps to prevent its retraction, but few spouting vessels will be found to tie, the bleeding having been at first in great part venous, and ceasing under the strong pressure exercised by the assistant.

After all bleeding has been stopped the upper end of the gut should be drawn down to the skin and loosely stitched there by a few sutures.

If much tension is required to hold it in this position, it will certainly tear out in three or four days, and in such cases it is best not to try to bring it down entirely to the surface, but simply to approximate it as nearly as possible. A drainage-tube is then passed into each fossa alongside of the gut, and the wound packed lightly with iodoform gauze not too heavily loaded with iodoform, for poisoning with the drug may easily occur.

When the disease does not involve the skin of the anus the operation may be modified somewhat to save the sphincters. The dorsal incision is then made, not behind the rectum, but through the anus up to the lower limit of the disease. The semicircular incisions are then begun within the gut and surround it—cut it across, in fact—half an inch below the level of the growth. The dissection is then continued as in the former case, and after excision of the mass the upper end is brought down and stitched to the sphincters as closely as may be without too much tension.

This, it is evident, is really an excision of the gut, and not an amputation, and it may leave the patient with a certain amount of sphincteric control.

In any case, the peritoneum may be opened in reaching the upper limit of the growth. It sometimes is reflected from the gut anteriorly at a distance of several inches from the perineum, and again it will be found within an inch and a half of the skin. The opening of the serous membrane is no contraindication to the operation. When it has been opened it is better to close it with catgut sutures, before stuffing the wound with gauze if possible, but even when the opening is merely plugged with the gauze the incision into the peritoneal cavity seems to add little to the mortality of the operation. Of course, should the gut tear loose from its attachments to the perineum and the bowels move, fæcal matter might be extravasated directly into the peritoneal cavity, with an immediately fatal result. This is best avoided by a preliminary colotomy and by free purgation, with milk diet and opium after the operation, by careful suturing of the peritoneum, and by drawing the end of the gut down to the perineum and binding it there. Fæcal extravasation is, however, one of the chief causes of death after extirpation.

This operation, with slight modifications to suit individual ideas, was the limit of our resources in dealing with cancer of the rectum till Kraske a few years ago conceived the idea of attacking these growths by means of an incision into the pelvis by the side of the sacrum. His first idea was that by this method of operation growths heretofore considered as inoperable might be reached, and all that part of the upper rectum above the limit of rectal digital examination, and below the reach of pelvic colectomy, might be brought into the field of operative

surgery. The operation has been extended, however, to cover not only resection of a portion of the rectum high up, with subsequent circular suture, but amputation of the entire rectum with the anus.

The operation consists in making a median incision from the second sacral vertebra to the anus; severing the left gluteus maximus from its sacral attachments; excising the coccyx; detaching the sacral attachments of the tubero-sacral and spinoso-sacral ligaments; and chiselling away the lateral mass of the sacrum in a curved line from the outer border of the third sacral foramen to the corner of the sacrum. The anus being next freed by a circular incision, the rectum is detached from its bed; the peritoneal cavity is also opened by a circular cut, the gut is drawn well down and amputated above the tumor, and its end fixed by sutures to the para-anal tissues. The operation is completed by passing a drainage-tube into the peritoneal cavity and plugging the rectum and wound with iodoform gauze.

The serious objection to this procedure lies in the non-closure of the peritoneal cavity, whereby death results from fæcal extravasation. To overcome this Schede, after following the preliminary steps described by Kraske, substituted the following modifications: In the first case he attached the free edge of the divided peritoneum to the serous surface of the gut, thereby closing the peritoneal cavity, and then sutured the upper and lower ends of the gut with a double row of circular sutures. The wound was dressed with iodoform gauze, and opium given to control the bowels. The operation was only unsatisfactory in the failure to get union of the sutured ends, and hence in the formation of a fæcal fistula.

The great value of closing the cavity of the peritoneum is shown in two of Kraske's operations in which it was omitted, although complete union of the divided ends of the bowel was attempted. In both instances the stitches gave way during a stool which occurred a few hours after the operation in spite of every precaution to prevent it, and death ensued from peritonitis due to fæcal extravasation.

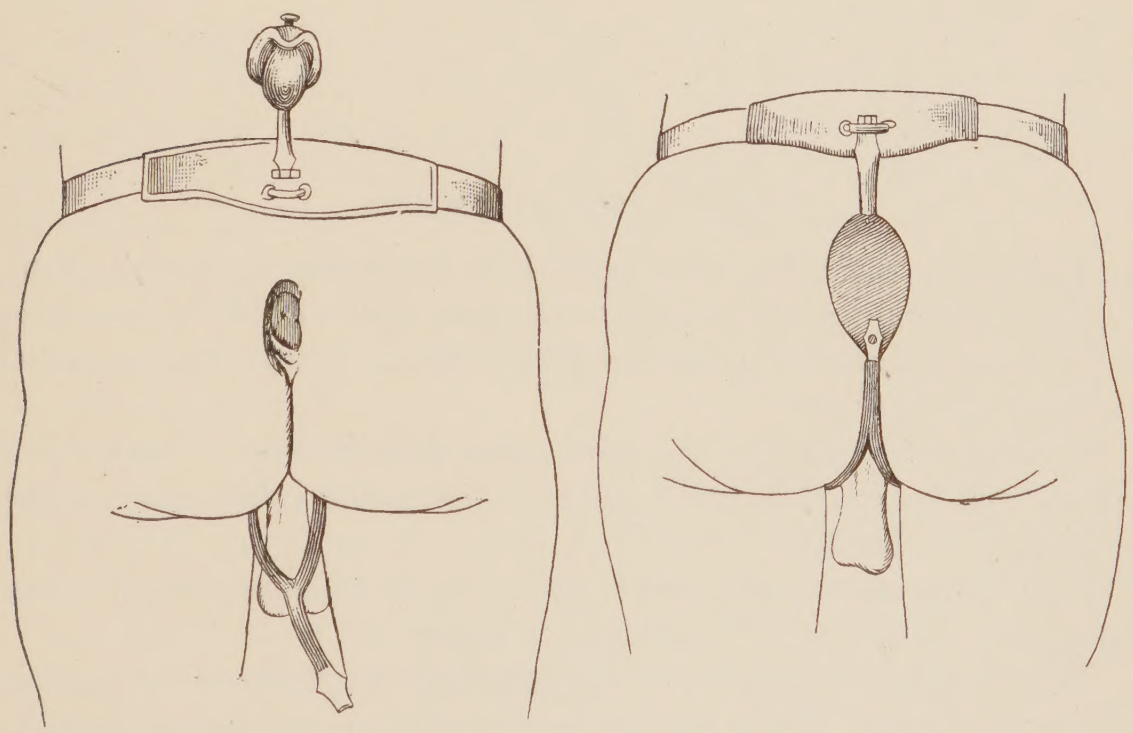
Schede, to avoid the fæcal fistula and protracted healing which occurred in his first case, modified the operation by doing a preliminary inguinal colotomy. In the first of these cases four-fifths of the rectal wound healed by first intention, and the balance by granulation; while in the second the wound had closed in two months and a half. The inguinal artificial anus was then closed by a plastic operation.

Bardenheuer extended the scope of the operation to cover certain bad cases of recto-vaginal and rectal fistulæ not amenable to other plans of operation. He performs the operation by dividing the sacrum transversely at the level of the third sacral vertebra, allowing the entire hand to be introduced into the pelvis. The left index finger is next introduced into the rectum, and the tumor pressed backward against

the dorsal incision, which is then continued till the posterior wall of the rectum is exposed in the wound. Both index fingers are next passed into the wound, and the tissues separated from the gut on all sides. A loop having been passed under the isolated portion of the gut, it is drawn out of the wound, and the tumor is separated from its bed in the same manner—first on its posterior, and then on its anterior, aspect—while in many cases the peritoneum can be stripped off without opening. Should, however, this cavity be opened, it is plugged with thymol gauze, and the operation completed by dividing the gut above and below the disease. The ends are then sutured and the wound plugged with iodoform gauze.

In certain cases in which, from the amount of rectum removed, it is impossible to unite the ends by suture, or where from the tightness of the stricture it has been impossible to empty the rectum above of fæces, or where the wound has been soiled by the same during the operation, Kraske postpones the suturing of the ends of the gut to a subsequent period; and forms a provisional sacral artificial anus at the upper angle of the dorsal incision. Hochenegg has devised the truss shown in the cut (Fig. 89) for these cases. Schede accomplishes the same

FIG. 89.



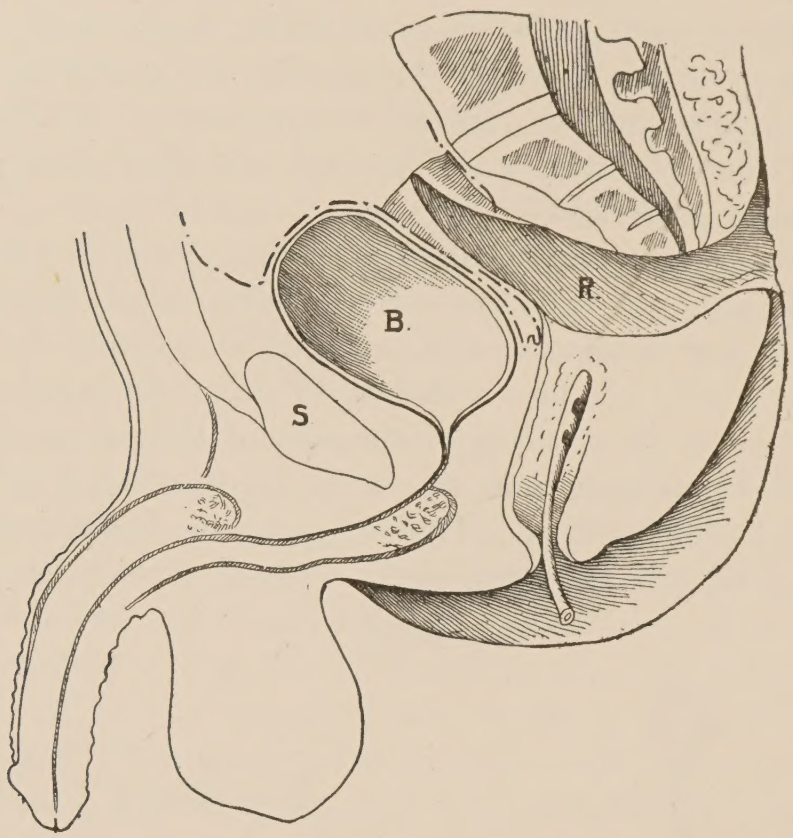
Truss used after Kraske's Operation.

end by a colotomy in the groin after the operation, and a subsequent closing of the inguinal artificial anus by a plastic operation.

Statistics of these operations are of little value, varying as they do with the skill of different operators and the cases selected for operation. Suffice it to say that the ratio of mortality is steadily decreasing with a constantly improving technique.

Hochenegg, in his last report of his own cases and those gathered from others, gives the following results of Kraske's method as distinguished from Bardenheuer's, which he considers essentially different. Out of 39 cases there were 31 recoveries and 8 deaths. Of primary

FIG. 90.



Permanent Sacral Artificial Anus.

circular suture there were 9 cases, with 3 completely successful results, 1 of partial healing, and 5 fatal. 14 cases were treated by formation of a permanent sacral artificial anus, with 12 recoveries. The mortality in all was 20 per cent.

Bardenheuer's statistics are better than these, and he believes that it can eventually be reduced to 5 per cent., except for complications, such as opening the bladder.

Von Bergmann prefers the operation to colotomy, and quotes Bramann's statistics—27 cases and 1 death.

The operation of excision is also applicable to cancer of the sigmoid flexure and colon which can be reached by an abdominal incision. Kendal Franks has collected 51 cases, from which he has drawn the following general conclusions: The operation rarely effects a radical cure. As a palliative measure it is justifiable and frequently demanded. Recurrence generally takes place in the liver or mesenteric glands, and gives an easier death. The mortality of the operation, with immediate suture of the gut and with the formation of an artificial anus, is about the same, and therefore immediate suture is to be preferred to the for-

mation of an artificial anus. The death-rate has been reduced in the later cases, and a still further reduction is to be expected.

Bryant expressed himself as against the operation. In malignant disease of the lower bowel we have to choose between colotomy, colectomy, and simply tiding the patient down hill, and he thinks the conclusion is in favor of colotomy, which gives comfort to the patient, prolongs life, and gives all the benefit colectomy can give. On looking over the tables it appeared that only 1 of the 51 cases had been cured; there were direct failures in 40, and indirect failures in 10 others. The operation was therefore dangerous and not to be recommended.

Treves speaks to the same effect. In only one case of the series presented was there no recurrence after four years, and cases of cancer which had been colotomized very commonly lived three or four years. In six years he had not seen a case in which he would have considered removing the colon for malignant disease.

Closure of Artificial Anus.

Mention has so frequently been made of the closure of a provisional artificial anus that a few words regarding the technique will not be out of place.

As I tried to bring out very strongly in describing the operation of colotomy, a provisional anus should be made very differently from a permanent one. The spur should not be as sharp, the gut should not be drawn as far out of the abdomen when it is stitched to the skin, and as little as possible of the wall of the gut should be pared away when it is incised. If these rules are followed in the original operation, it will generally be possible to close the opening without having to destroy the spur, and the operation is thus changed from a serious one to one of trifling gravity

In a case in which there is not sufficient flexure of the wall of the gut to make the removal of the spur thus formed necessary, the opening may be closed by one of two plastic operations. The simplest consists in paring the free edges of the mucous membrane, loosening them from the edges of the wound as far as possible without opening the peritoneum, and suturing them with a continuous suture, turning the free edges either into the lumen of the gut or out of it as the operator prefers. The muscular and peritoneal layers are next to be treated in exactly the same way, and finally the muscular layer of the abdominal wall is freshened and united by deep catgut sutures, and the skin closed.

It is manifest that in freshening the edges of the intestinal wall preparatory to suturing them several centimetres of tissue will be lost, and that this will be increased by the line of suture. This operation

can therefore seldom be applicable without previous allowance for this loss of calibre by destruction of the opposite angle of the gut by the enterotome.

Szymanowski's operation, on the other hand, has the advantage of closing the opening by a flap of integument, without any sacrifice of the intestinal wall. The cuts (Figs. 91–94) illustrate it very well. A

FIG. 91.

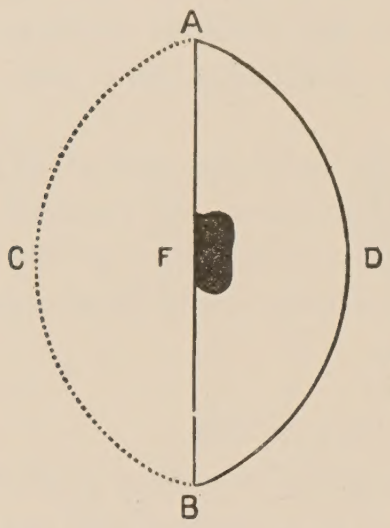


FIG. 92.

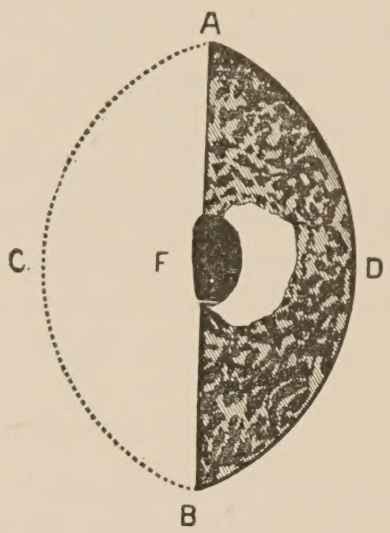


FIG. 93.

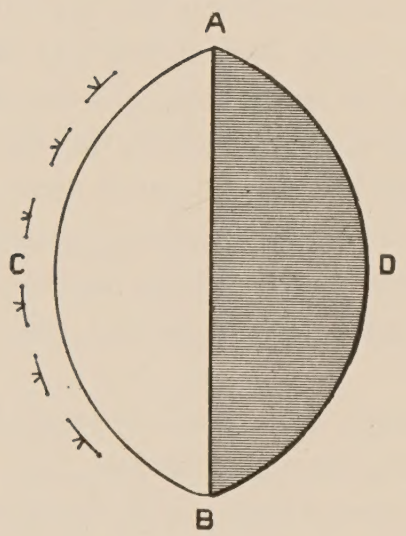
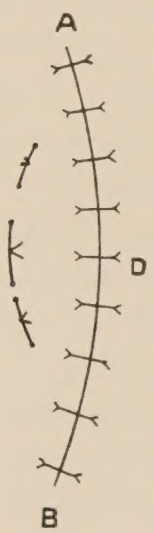


FIG. 94.



Szymanowski's Operation for Fistula (McBurney).

single straight incision is made from A, three-quarters of an inch in front of, to B, three-quarters of an inch behind the fistula (Fig. 91). This incision passes through skin and superficial fascia, and closely skirts the left edge of the fistula. The edge of this incision is raised, and, working toward the patient's left side with a small blade, the skin and fascia are undermined until a pocket is formed, including the area A, C, B, F, the left edge of this pocket being indicated by the dotted line A, C, B. On the opposite side the curved incision A, D, B is then made, the greatest width of the flap thus marked out being from three-quar-

ters of an inch to an inch. This flap should be generous, and include a good padding of fascia, as, after lifting, the shrinkage is great.

Before lifting this flap a thin layer of skin is removed from its surface. This is best done with small curved scissors, the superficial layer of skin being rapidly snipped off. The freshening process is carefully extended over the entire area A, D, B, F, excepting over a surface a little larger than the fistula and immediately next to it. The flap A, D, B is then dissected up close to the median line and inverted, its attached edge acting as a hinge and as a medium for blood-supply. Five or six fine catgut sutures are passed through the skin at different points a little beyond the dotted lines A, C, B into the pocket, then through the free edge of the flap, and then back into the pocket and out through the skin. Five or six loops are thus formed, by drawing upon which the flap is closely drawn down to the bottom of the pocket, and the free ends of the loops are tied (Fig. 94). Two or three sutures of catgut are now passed with a curved needle through the upper surface of the inverted flap, so as to bind it firmly to the parts beneath. Either with a continuous or an interrupted suture of catgut the free edge A, F, B is finally securely fastened to the edge A, D, B.

Neither of these methods involves opening of the peritoneum, and there is therefore no mortality attendant upon them. When the enterotome is used to destroy the spur, the operation is more serious. Dupuytren's statistics covered 41 cases, 3 of which were fatal. More recent statistics by Pollason give the following results: In 95 cases, 60 complete cures; 26 cases of persistence of the fistula; and 9 deaths, 4 of them directly attributable to the operation.

In some cases a cure may not be possible without a free dissection of the ends of the gut and an anastomosis, though this applies much more frequently to fæcal fistulæ than to artificial anus. In such cases the operator must choose between the different methods now in vogue—lateral anastomosis with rings, end-to-end suture with rings, or simple circular suture without rings. The latter procedure seems at the moment of writing the most to be preferred, from its simplicity and ease of performance. The old elaborate suturing formerly in vogue in this operation has been practically abandoned, and an operation which previously required hours of suturing is now done by an average operator with equally good results in twenty minutes or half an hour.

One point of importance in the formation of provisional artificial anus must be borne in mind. The distal extremity of the gut tends to very rapid contraction and atrophy from want of use, and a difference in size of the proximal and distal ends may result in a few weeks, which will make an end-to-end suture almost impossible. This may be prevented and the calibre of the distal portion preserved by daily injec-

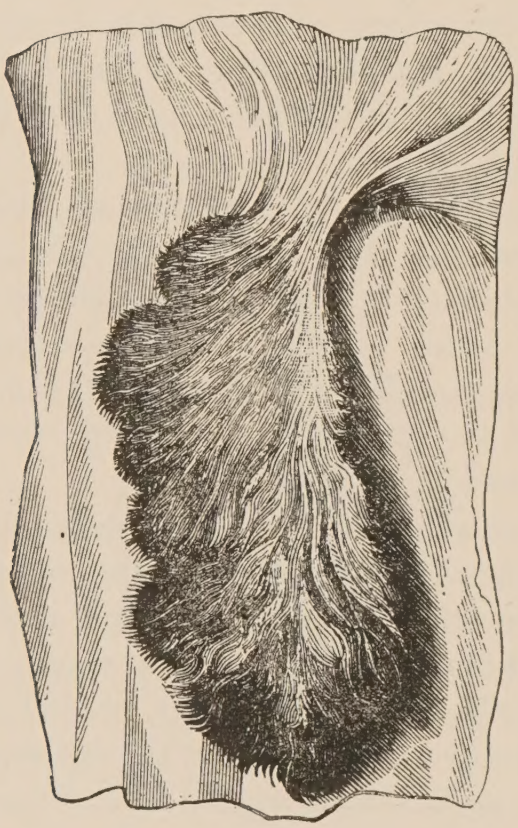
tions of milk through the artificial anus, and daily enemata of water from below.

Benign Tumors.

Under this head are included polypus, vegetations, condylomata, fibromata, lipomata, enchondromata, and the various forms of cysts, congenital or otherwise.

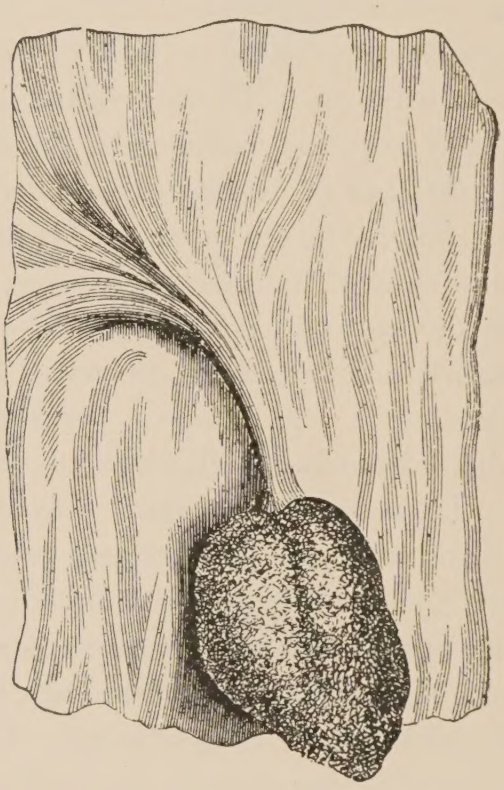
Polypus occurs in several different forms. The soft variety is similar to that found in the nose, and is composed only of the elements of the mucous membrane; the hard variety contains fibrous tissue. The soft polypus is made up in great measure of hypertrophied villi; the substance is homogeneous, and the fluid pressed from it contains many cylindrical epithelial cells; the tumor is often not larger than a pigeon's egg, but has been known to reach the size of an orange. This form of growth is shown in Fig. 95. The glandular or adenomatous polypi

Fig. 95.



Soft Polypus.

Fig. 96.



Hard Polypus.

are well shown in Fig. 96. These may be due either to hypertrophy of the closed follicles or the follicles of Lieberkuhn. They occur most often in the young, are generally the size of a plum, but may reach that of a small pear, and have been known to weigh four pounds. They are vascular, smooth, or mammillated, and are attached by a pedicle of greater or less strength and length. When the pedicle is absent and these tumors grow in the substance of the rectal wall, instead of away from it into the cavity of the gut, they approach to

malignancy, and some are both microscropically and clinically difficult to distinguish from malignant adenomata.

These adenomatous polypi may be multiple, may cover a considerable extent of surface, and may also be recurrent. These cases are rare, and the recurrence may be the only sign of malignancy, the tumors reappearing with the same benign characteristics many times.

The hard fibrous polypus (sarcomatous polypus) is composed primarily of the elements of the submucous connective tissue, chiefly of fibrous tissue resembling the uterine fibroid, but may contain both muscular and glandular elements. When the glandular element contains fluid resembling glue, these tumors have been described as colloid, and when fluid with a jelly-like substance, they have been spoken of as myxomata.

There are also other forms of benign polypi which are difficult to classify—tumors of more or less density and vascularity, disseminated or single, such as have been described as granular papillomata, villous tumors, and peculiar bleeding tumors.

Polypus is confined to no age. It may exist from childhood and cause no symptoms till adult age. It may act merely as a foreign body, being extruded at stool when the pedicle is long enough, and occasionally bleeding when the surface has become eroded. On the other hand, it may set up much surrounding trouble. Some of the worst cases of bleeding and erosion of the rectum, with tenesmus, pain, and mucous discharge, I have ever seen—cases in which from the history a diagnosis of malignant disease seemed evident—have been due to the presence of one or two small polypoid growths high up in the rectum, not larger than the end of the index finger; and scraping off these tumors with the finger-nail has at once put an end to all symptoms.

The treatment of polypus is a simple matter, and consists solely in removal. When there is a pedicle it should be tied to prevent possible hæmorrhage. When there is no pedicle, the tumor may be curetted off, either with the sharp spoon or the finger-nail. In the multiple and recurrent variety it is perhaps well not to be too radical in treatment. When the tumors have attained considerable size and bleed a good deal, they may be broken off with dressing-forceps and the end of the finger, but the application of acids or the cautery to the surface from which they spring is seldom effectual in preventing recurrence, and in one of my cases seemed to be followed by a decided increase in the gravity of the affection.

The perineum is a favorite site for warts or papillomata composed of an hypertrophy of the papillary layer of the skin. They owe their origin to a special predisposition in certain people and to any irritation affecting this part. Thus the discharge of gonorrhœa or leucorrhœa

may cause them to grow, and yet they may appear in persons of perfectly cleanly habits. Pregnancy has an undoubted influence on their causation, and in such cases they may disappear spontaneously after delivery. Under any of these influences little tumors like ordinary warts may appear and rapidly multiply. When the wart is isolated, it is dry; when several are united, they become macerated in the secretion of the part; the tumor becomes moist and fœtid, and all the adjacent surfaces become irritated. According to the size of the growths, the condition of the patient, the abundance of the secretions, and the irritation to which they owe their origin, the growths take on various shapes, and have been described as cockscombs, cauliflower excrescences, etc. They may occur at any age, and may vary in size from a single enlarged papilla to a mass filling the perineal region and weighing a pound. They were formerly considered as proof positive of syphilis, and even of sodomy, but they are distinctly non-syphilitic, and must not be confounded with true condylomata or the vegetating mucous patch, although rare cases have been reported in which the two have existed together, the wart being caused by the irritation of the raised mucous patch.

The best method of treatment is to cut the warts down to the surface of the skin with scissors, although they may be induced to dry and shrink up by applications of astringent powders.

The other forms of benign growths, fibromata, cysts, etc., are so rare as scarcely to require special description here.

Pruritus.

Itching at the anus is an exceedingly common, painful, and annoying symptom, either of some local disease of the parts or of a constitutional condition.

The itching is more or less constant, but is particularly apt to be worse after the sufferer goes to bed at night. This is so frequent a symptom that many explanations have been suggested for it, the real one being probably found in the change in the circulation which occurs immediately after the patient assumes the recumbent posture.

The disease is sometimes attended by changes in the appearance of the parts. The skin is thickened and parchment-like, or else eczematous and moist from exudation. There may be a characteristic loss of the natural pigment of the part. The exudation may be very profuse, though the itching is but slight, and may deceive the examiner into the belief that it comes from within the rectum and is due to fistula or ulceration.

Pruritus is often dependent upon internal hæmorrhoids, and many otherwise incurable cases may be cured by an operation upon the piles. It is sometimes a complication of fistula with an external opening, or

of any ulcerative process the discharge of which keeps up an irritation of the skin. It may be dependent upon pin-worms, and in every case these should be carefully watched for. Instead of a parasite within the rectum, the itching may be due to the presence of pediculi. In such case the diagnosis and cure are alike easy. Or the parasite may be vegetable instead of animal, and the itching may be due to the disease known as *eczema marginatum*. In this case the microscope may be necessary for the diagnosis, but not often. Such cases are easily cured by any of the parasiticidal preparations, such as sulphurous acid, iodine, or mercury.

Pruritus is perhaps most frequently a symptom of chronic eczema of the parts, and thus must be treated here exactly as elsewhere in the body—first, by general, and second, by local, measures. The congestion and thickening of the skin may be reduced by applications of strong tincture of green soap, or by nitrate of silver in varying strength according to the amount of infiltration. Very hot water will be found of benefit, applied for ten minutes three times a day, and followed by an ointment to soften the skin and allay the itching. A good ointment is oxide of zinc made soft and applied gently. Chloroform ointment is an old favorite, made in the strength of 1 drachm to the ounce. Another application which is efficient is made of carbolic acid ½ ounce, glycerin 1 ounce, and water 3 ounces. This may be used at night. A solution of the liquori plumbi subacetatis in milk (1 part to 7), applied on a pledget of cotton, will sometimes secure a night's rest. Allingham uses the following:

Liq. carbonis detergens (Wright's),	
Glycerinæ,	*āā.* ℥j;
Pulv. zinci oxidi,	
Cretæ præp.,	*āā.* ℥ss;
Pulv. sulph. præcip.,	℥ss;
Aquæ,	ad ℥vj.—M.

The parts to be thickly painted over with this once or twice a day, and allowed to dry.

Two other skin diseases, herpes and erythema, may each be attended by a good deal of itching, and in both the application of powders, such as zinc or bismuth, will act better than salves or lotions.

These are the most palpable, and perhaps the commonest, causes of pruritus, but there are many cases in which the cause is not easily discoverable, because it is a constitutional, and not a local, one. The most careful supervision must always be exercised over the general health. If constipation exists, it must be remedied; if the liver be torpid, it must be stimulated. Alcohol in excess is always bad. The

condition seems sometimes to be a pure neurosis, and must be treated accordingly. Smoking and coffee in such persons may have an undoubted bad effect. Finally, the symptom may be inexplicable except upon the basis of the gouty diathesis, which of course must be treated.

In this way, then, the cure of a case of pruritus must be undertaken, and I know of no disease of the rectum or anus better calculated to test the ingenuity and general medical skill of the practitioner.

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